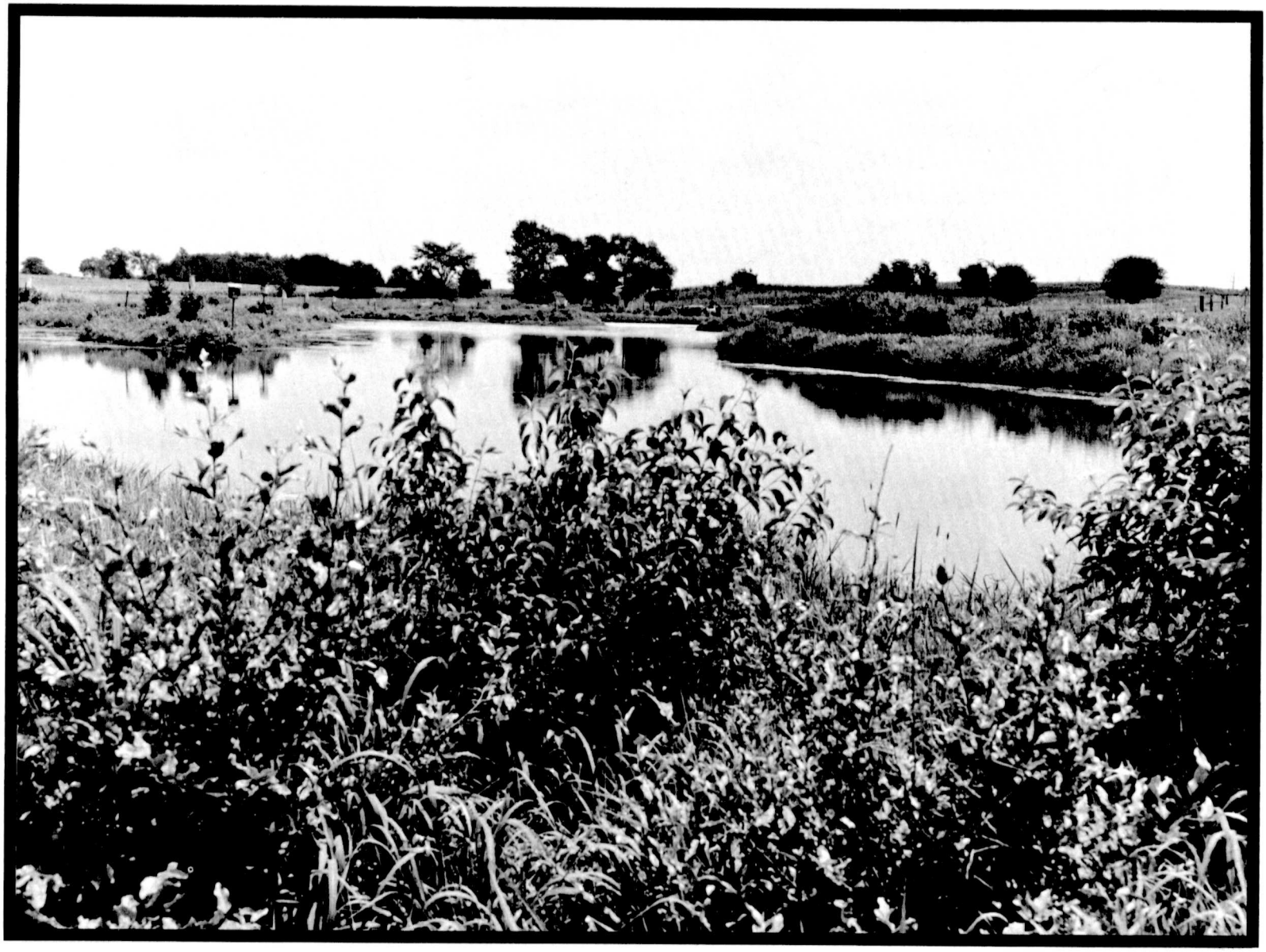
SOIL SURVEY OF

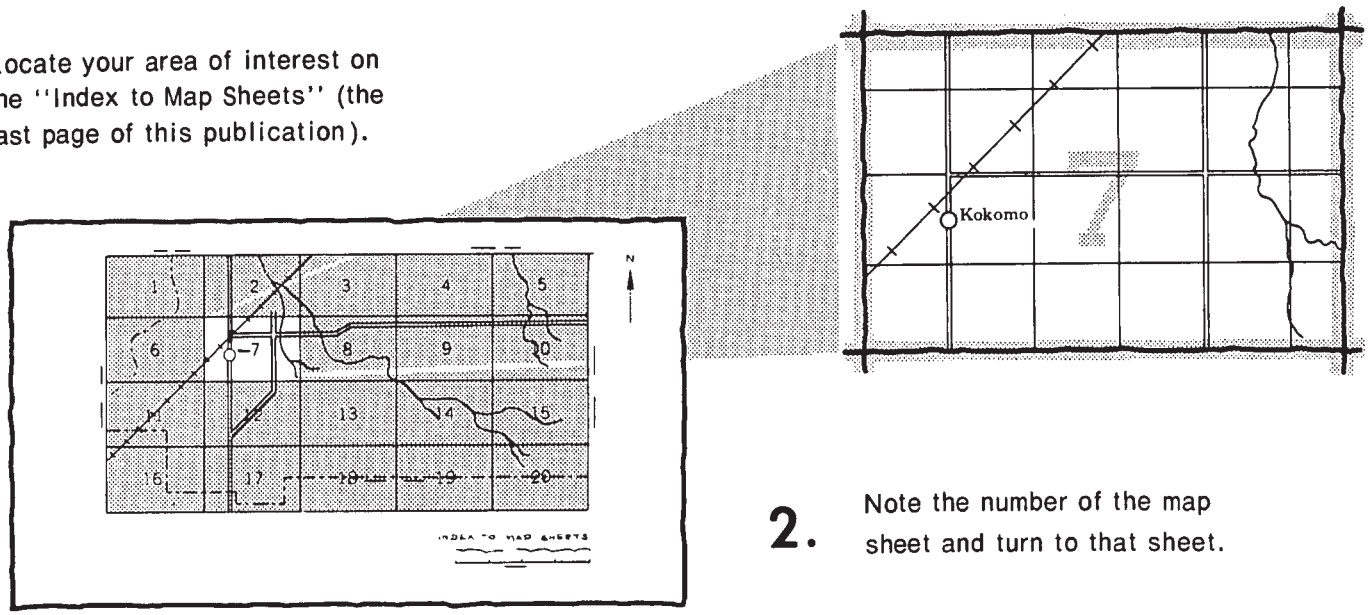
Marshall County, Indiana



United States Department of Agriculture
Soil Conservation Service
in cooperation with
Purdue University Agricultural Experiment Station and
Indiana Department of Natural Resources
Soil and Water Conservation Committee

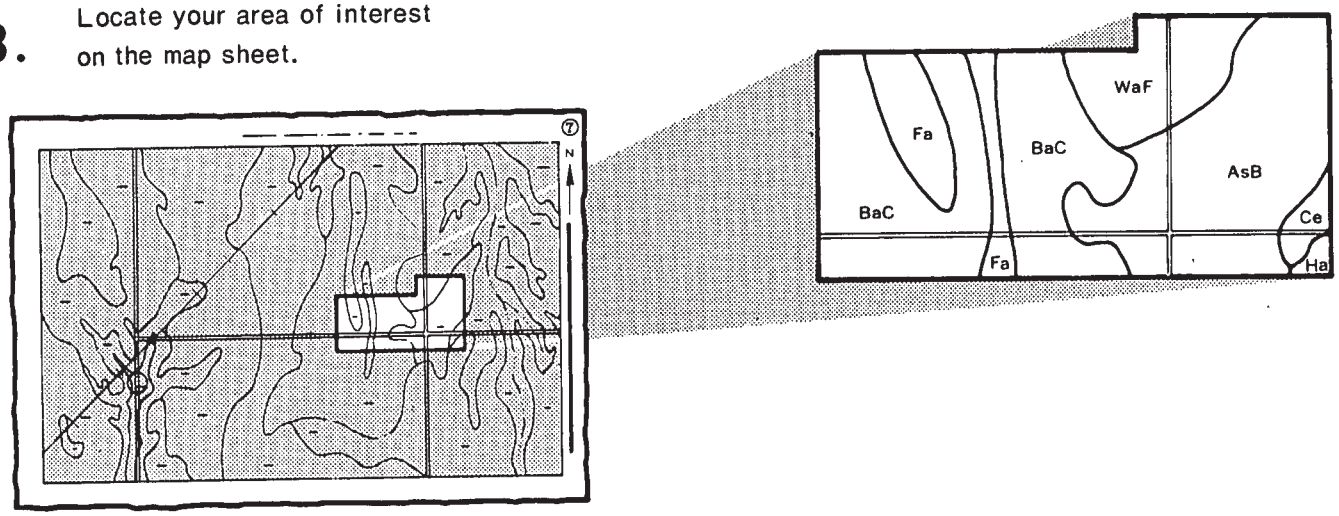
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

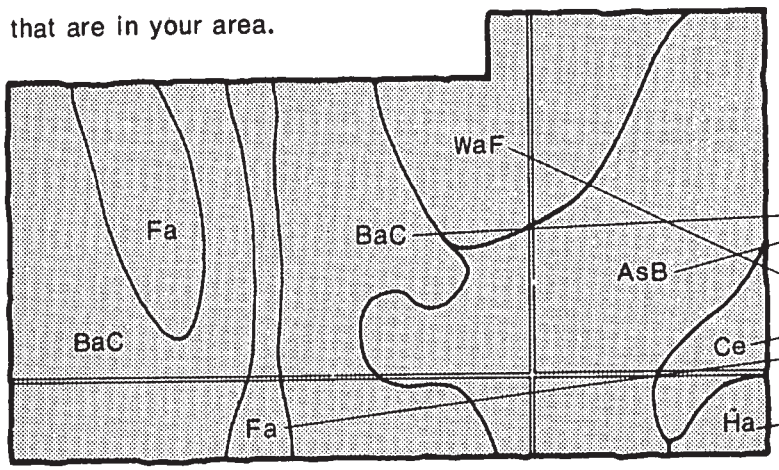


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.



Symbols

AsB
BaC
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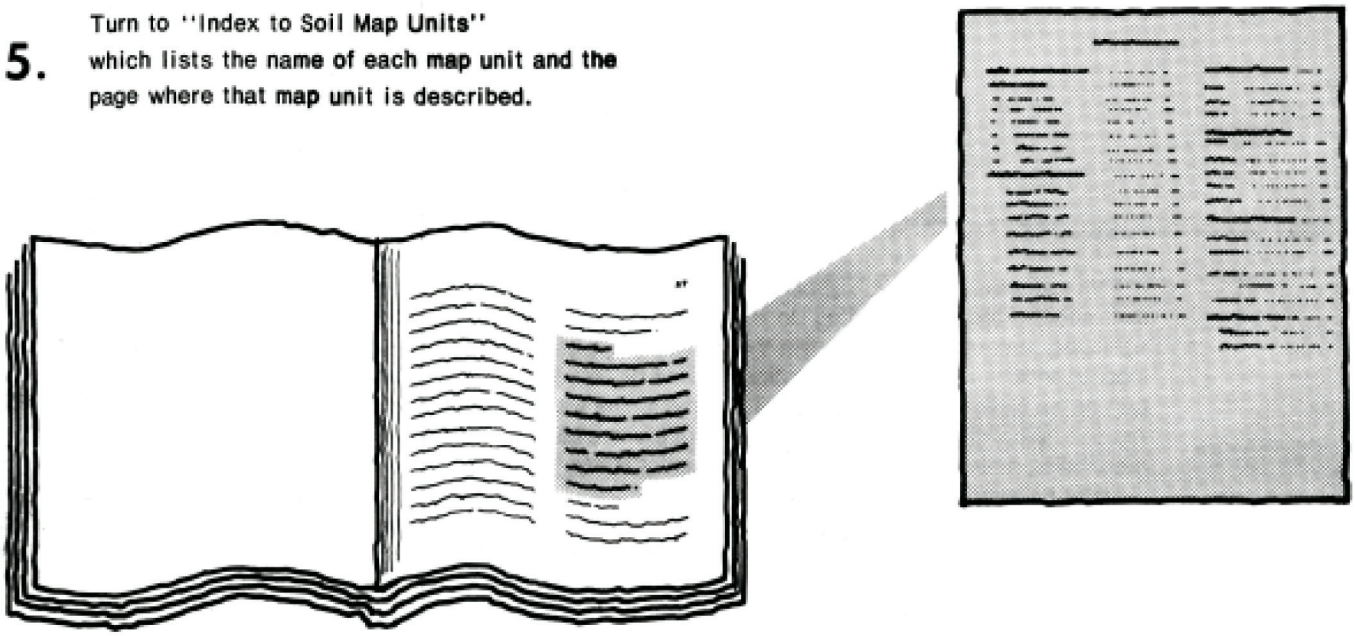
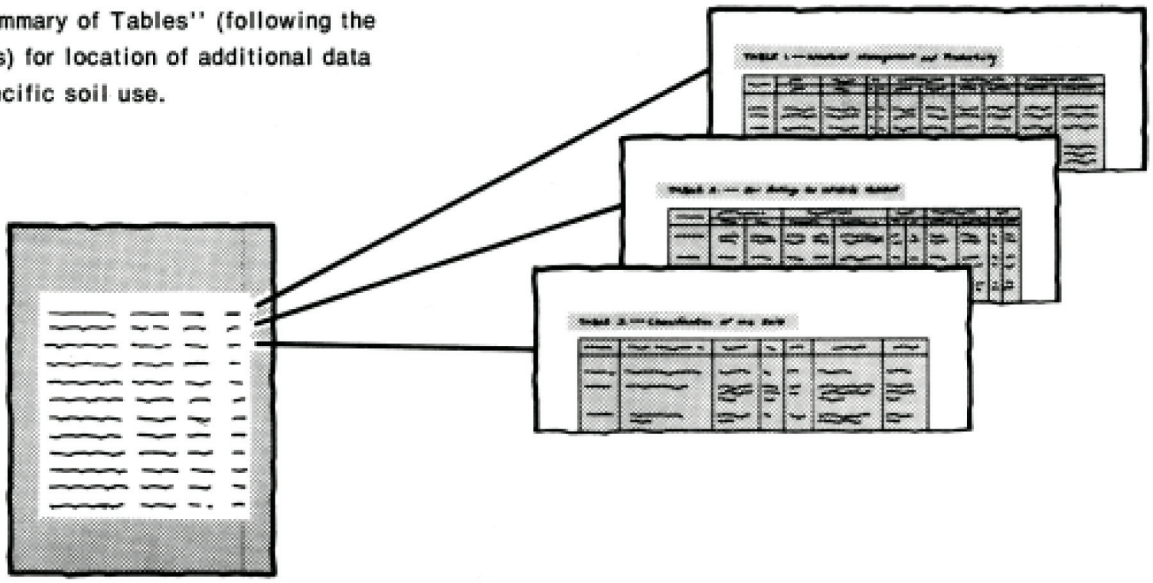
THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service, the Purdue University Agricultural Experiment Station, and the Indiana Department of Natural Resources, Soil and Water Conservation Committee. It is part of the technical assistance furnished to the Marshall County Soil and Water Conservation District. Financial assistance was made available by the Marshall County Board of County Commissioners. Major fieldwork was performed in the period 1971-78. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978.

Cover: Pond in an area of Houghton muck. This area provides habitat for a wide variety of fish and wildlife.

contents

soil series

Issued October 1980

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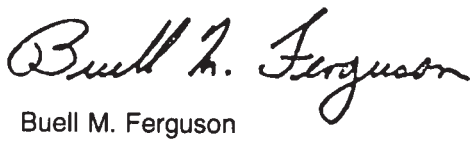
foreword

This soil survey contains information that can be used in land-planning programs in Marshall County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Buell M. Ferguson
State Conservationist
Soil Conservation Service

Location of Marshall County in Indiana.

soil survey of
Marshall County, Indiana

By Benjamin F. Smallwood, Soil Conservation Service

Fieldwork by Benjamin F. Smallwood, Hezekiah Benton, Jr., and Bobby L. Pirtle, Soil Conservation Service, and Bruce K. Petersen, Jerry W. Heltsley, and Thomas C. Hunt, Indiana Department of Natural Resources, Soil and Water Conservation Committee

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Purdue University Agricultural Experiment Station and the Indiana Department of Natural Resources, Soil and Water Conservation Committee

MARSHALL COUNTY is in northern Indiana. Its area is 449 square miles, or 287,360 acres. The county is on a relatively flat plain dissected by the Yellow and Tippecanoe Rivers and numerous creeks, streams, and drainageways. Abruptly changing microrelief characterizes the area. Elevation ranges from 705 feet to about 895 feet above sea level.

general nature of the county

Marshall County was platted in 1878. Prior to this the Michigan Road crossed the area, helping to beckon some of the county's early settlers. The county was named for Chief Justice Mahlon W. Marshall, who donated land for a railroad station. Plymouth was platted in 1834 and named after Plymouth, Massachusetts. It is the county seat and largest community.

The population of Marshall County was about 35,000 in 1970 and an estimated 38,500 in 1977. In 1977 the population density was 87 people per square mile. The population increased 7.8 percent between 1960 and 1970. The projected population increase between 1970 and 1980 is about 9 percent. In 1977, Plymouth had approximately 10,000 people. About half of the town's work force is engaged in agricultural trades and government service. The rest are employed in business and manufacturing.

About 81 percent of the county is actively farmed. Corn, soybeans, and small grains are the major crops. Small but productive truck farms and farms of other specialy crops, such as Christmas trees and orchard fruits, are located throughout the county.

Between 1970 and 1977, urbanized land increased by less than 5 percent. Most of the active urban development is taking place around Breman and Plymouth and in the Twin Lakes area. Lot-by-lot development occurs throughout the county. This trend is expected to continue at a slightly increased rate.

Marshall County has 1,051 miles of Federal, State, and county roads. Virtually every road is paved. There are two small airports. Four main railroad lines cross the county.

The first soil survey of Marshall County was made in 1904 (*6*). The current survey updates the first survey and provides additional information and larger maps that show the soils in greater detail.

relief

Marshall county is generally flat to gently rolling. Relief is low with abrupt changes. The southeastern part of the

county is generally more rolling than the rest, and the northeastern part is more nearly level. Slope ranges from 0 to about 18 percent.

The highest point in Marshall County is 895 feet above sea level. It is near the junction of Kenilworth Road and Indiana Route 110 in Green Township. The lowest point in the county is 705 feet at a spot directly north of U.S. Route 6 where the railroad crosses the St. Joseph County line in Polk Township.

There are 19 lakes in the county. They range in size from Lake Maxinkuckee (1,868 acres) to Thomas Lake (6 acres). Numerous small ponds are throughout the county.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Marshall County is cold in winter but quite hot in summer. Winter precipitation, which is frequently snow, provides a good accumulation of soil moisture by spring and minimizes drought during summer on most soils. Annual precipitation is normally adequate for all crops adapted to the temperature and growing season of this area.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Plymouth in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 19 degrees. The lowest temperature on record, which occurred at Plymouth on January 28, 1963, is -24 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred at Plymouth on June 20, 1953, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 37 inches. Of this, 22 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.37 inches at Plymouth on October 3, 1954. Thunderstorms occur on about 43 days each year, and most occur in summer.

Average seasonal snowfall is 36 inches. The greatest snow depth at any one time during the period of record was 19 inches. On an average of 23 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally. These storms are usually local and short. They cause damage in a variable pattern.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the potential of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, woodland, urban uses,* and *intensive recreation areas*. Cultivated crops are those grown extensively in the survey area. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic.

The names, descriptions, and delineations of soils on the general soil map of this county do not always agree or join fully with those of adjacent counties published earlier. These differences are caused by changes in concepts of soil series and in the application of the soil classification system and by differences in proportions of soils in map units made up of two or three series. Still other differences may be caused by differences in the range in slope in the map units. In this county or in adjacent counties some soil areas are too small to be delineated.

descriptions of the map units

1. Oshtemo-Owosso-Fox

Nearly level to strongly sloping, well drained, moderately coarse textured and coarse textured soils; some are deep and some are moderately deep over sand and gravel; on outwash plains and moraines

This map unit is on knolls and ridges of moraines and outwash plains. Topography is nearly level to rolling.

This map unit covers about 15 percent of the county. It is about 60 percent Oshtemo soils, about 16 percent Owosso soils, 14 percent Fox soils, and 10 percent soils of minor extent.

The well drained, nearly level to strongly sloping Oshtemo soils are on low knolls and ridges of moraines and outwash plains. They have a dark grayish brown loamy sand surface layer. They are moderately rapidly permeable in the subsoil and very rapidly permeable in the substratum.

The well drained, nearly level Owosso soils are on plains between the moraines. They have a dark grayish brown sandy loam surface layer and are moderately permeable.

The well drained, gently sloping to moderately sloping Fox soils are on knolls and sides of moraines. They have a dark grayish brown sandy loam surface layer. They are moderately permeable in the subsoil and rapidly permeable in the substratum.

Minor in this unit are well drained Linkville soils on broad undulating areas, somewhat poorly drained Brady soils in slightly lower areas, somewhat poorly drained Fluvaquents in nearly level areas along major streams, and very poorly drained Gilford soils in the lowest areas and in poorly defined drainageways.

The main use of this unit is farming. Corn, soybeans, and small grains are the major crops. Hay and pasture are minor crops. Other uses include woodland and urban land. A few small areas are mined for sand and gravel.

This map unit is suited to cultivated crops, hay, and pasture. Slope and droughtiness are the main limitations. Various conservation practices can be used to reduce these limitations.

The major soils in this unit are well suited to trees. Removing unwanted species may be necessary to improve stands.

This unit is poorly suited to sanitary facilities and well suited to building sites. Slope and poor filtering qualities are the major limitations.

2. Plainfield-Chelsea-Tyner

Deep, nearly level to strongly sloping, excessively drained and well drained, coarse textured soils; on outwash plains

This map unit is on glacial outwash plains. Topography is flat and rolling.

This map unit covers about 11 percent of the county. It is about 32 percent Plainfield soils, 27 percent Chelsea soils, 22 percent Tyner soils, and 19 percent soils of minor extent.

The excessively drained, nearly level to strongly sloping Plainfield soils are on flats and knolls within the outwash plains. They have a dark brown sand surface layer and are rapidly permeable.

The excessively drained, gently sloping to moderately sloping Chelsea soils are in undulating areas within the outwash plains. They have a dark brown fine sand surface layer and are rapidly permeable.

The well drained, nearly level to moderately sloping Tyner soils are on outwash plains. They have a dark brown loamy sand surface layer and are rapidly permeable.

Minor in this unit are moderately well drained Brems soils on outwash plains; very poorly drained Gilford soils in low, level areas; and very poorly drained Adrian and Houghton soils in depressions.

The main use of this unit is farming. Corn, soybeans, and small grains are the major crops. Hay and pasture are minor crops. Other uses include specialty crops, woodland, and urban land.

This map unit is poorly suited to cultivated crops. Slope and droughtiness are the main limitations. Various conservation practices can be used to reduce these limitations.

The major soils in this unit are suited to trees. Removing unwanted species may be necessary to improve stands.

This unit is poorly suited to sanitary facilities and well suited to building sites. Slope and poor filtering qualities are the major limitations.

3. Rensselaer-Whitaker

Deep, nearly level, very poorly drained and somewhat poorly drained, medium textured soils; on outwash plains, lake plains, and terraces

This map unit is on nearly level or depressional outwash plains, lake plains, and terraces. Topography consists of swales and swells.

This map unit covers about 12 percent of the county. It is about 57 percent Rensselaer soils, 30 percent Whitaker soils, and 13 percent soils of minor extent.

The very poorly drained, nearly level Rennsselaer soils are on flats or in slight depressions on the outwash plains and lake plains. They have a very dark gray loam surface layer and are slowly permeable.

The somewhat poorly drained, nearly level Whitaker soils are in slightly higher positions. They have a dark grayish brown loam surface layer and are moderately permeable.

Minor in this unit are well drained Martinsville soils on terraces and somewhat poorly drained Aubbeenaubbee and Crosier soils on broad flats and low knolls.

The main use of this unit is farming. Corn, soybeans, and small grains are the major crops. Hay and pasture are minor crops. Other uses include woodland and urban land.

This map unit is well suited to cultivated crops, hay, and pasture. Wetness is the main limitation. Various conservation practices can be used to reduce this limitation.

The major soils in this unit are suited to trees. Removing unwanted species may be necessary to improve stands.

This map unit is poorly suited to sanitary facilities and building sites. Wetness is the major limitation.

4. Crosier-Brookston

Deep, nearly level, somewhat poorly drained and very poorly drained, medium textured soils; on till plains and moraines

This map unit is on nearly level or depressional till plains and moraines. Topography consists of swales and swells.

This map unit covers about 16 percent of the county. It is about 44 percent Crosier soils, 37 percent Brookston soils, and 19 percent soils of minor extent.

The somewhat poorly drained, nearly level Crosier soils are on broad flats and swells on the till plains. They have a dark grayish brown loam surface layer and are moderately slowly permeable.

The very poorly drained, nearly level Brookston soils are on broad flats and in swales along drainageways. They have a very dark gray loam surface layer and are moderately permeable.

Minor in this unit are well drained Riddles soils on knolls and ridges, somewhat poorly drained Aubbeenaubbee soils on low knolls, and very poorly drained Rensselaer soils on broad flats.

The main use of this unit is farming. Corn and soybeans are the major crops. Hay, pasture, and woodland are minor uses. Few areas are in urban land.

This map unit is well suited to cultivated crops. Wetness is the main limitation. Various drainage practices can be used to reduce this limitation.

The major soils in this unit are suited to trees. Water-tolerant species should be selected.

This unit is poorly suited to sanitary facilities and building sites. Wetness and ponding are the major limitations.

5. Riddles-Metea-Wawasee

Deep, nearly level to strongly sloping, well drained, moderately coarse textured and coarse textured soils; on moraines

This map unit is on knolls and ridges of moraines. Topography is rolling.

This map unit covers about 36 percent of the county. It is about 54 percent Riddles soils, 22 percent Metea soils, 13 percent Wawasee soils, and 11 percent soils of minor extent.

The well drained, nearly level to strongly sloping Riddles soils are on ridges of moraines. They have a dark brown sandy loam surface layer and are moderately permeable.

The well drained, gently sloping to moderately sloping Metea soils are on low knolls and sides of moraines. They have a dark brown loamy fine sand surface layer. They are very rapidly permeable in the upper part of the solum and moderately permeable in the lower part of solum and in the substratum.

The well drained, gently sloping to strongly sloping Wawasee soils are on ridges of moraines. They have a brown sandy loam surface layer and are moderately permeable.

Minor in this unit are somewhat poorly drained, nearly level Fluvaquents on flood plains and very poorly drained Brookston, Rensselaer, and Washtenaw soils along poorly defined drainageways and in depressions.

The main use of this unit is farming. Corn, soybeans, and small grains are the major crops. Hay and pasture are minor crops. Other uses include woodland and urban land.

This map unit is suited to cultivated crops, hay, and pasture. Slope is the main limitation. Various conservation practices can be used to reduce this limitation.

The major soils in this unit are well suited to trees. Removing unwanted species may be necessary to improve stands.

This unit is suited to sanitary facilities and building sites. Slope and moderately fine texture of the subsoil are the major limitations.

6. Martinsville-Riddles

Deep, nearly level to strongly sloping, well drained, medium textured and moderately coarse textured soils; on terraces, outwash plains, and moraines

This map unit is on knobs and ridges of terraces, outwash plains, and moraines. Topography is rolling.

This map unit covers about 4 percent of the county. It is about 50 percent Martinsville soils, 34 percent Riddles soils, and 16 percent soils of minor extent.

The well drained Martinsville soils are on upland terraces and higher positions on the outwash plains. They have a dark grayish brown loam surface layer and are moderately permeable.

The well drained Riddles soils are on broad uplands and ridges of moraines. They have a dark brown sandy loam surface layer and are moderately permeable.

Minor in this unit are somewhat poorly drained Crosier soils on flats and swells and very poorly drained Rensselaer soils on broad flats and in swales along drainageways.

The main use of this unit is farming. Corn, soybeans, and small grains are the major crops. Hay and pasture are minor crops. Other uses include woodland and urban land.

This map unit is suited to cultivated crops. Slope is the main limitation. Various conservation practices can be used to reduce this limitation.

The major soils in this unit are well suited to trees. Removing unwanted species may be necessary to improve stands.

This unit is suited to sanitary facilities and building sites. Slope is the major limitation.

7. Houghton-Adrian-Palms

Deep, nearly level, very poorly drained, organic soils; in bogs and on old lakebeds on till plains, outwash plains, and moraines

This map unit is in bogs and on old glacial lakebeds. Topography is depressional.

This map unit covers about 6 percent of the county. It is about 53 percent Houghton soils, 22 percent Adrian soils, 11 percent Palms soils, and 14 percent soils of minor extent.

The very poorly drained, nearly level Houghton soils are in depressions on moraines, outwash plains, and lake plains. They have a black muck surface layer. They are moderately slowly permeable to moderately rapidly permeable.

The very poorly drained, nearly level Adrian soils are in depressions on moraines, outwash plains, and lake plains. They have a black muck surface layer. They are moderately slowly permeable to moderately rapidly permeable in the organic material and rapidly permeable in the underlying sandy material.

The very poorly drained, nearly level Palms soils are in depressions on moraines, outwash plains, and lake plains. They have a black muck surface layer. They are moderately slowly permeable to moderately rapidly permeable in the organic material and moderately permeable in the underlying loamy material.

Minor in this unit are very poorly drained Gilford and Rensselaer soils on somewhat higher flats and along drainageways.

The main use of this unit is farming. Corn and soybeans are the major crops. Specialty crops are grown in some areas. Pasture and woodland are minor uses. Few areas are in urban land.

This map unit is suited to cultivated crops. Wetness is the major limitation. Various drainage practices can be used to reduce this limitation.

The major soils in this unit are poorly suited to trees. The major limitations are wetness and ponding.

This unit is poorly suited to sanitary facilities and building sites. Wetness, ponding, and excess humus are severe limitations.

broad land use considerations

Deciding which land should be used for urban development is an important issue in the survey area. Each year a significant amount of land is developed for urban uses in Plymouth and Bremen and in Center, German, Union, West, and Walnut Townships. In 1978, about 18,000 acres in Marshall County was urban or built-up land.

The general soil map is most helpful in planning the general outline of urban areas. It cannot be used for selecting sites for specific structures. Data on specific soils given in other parts of this survey can be helpful in planning land use.

Extensive areas in this county are so unfavorable for urban uses that development is not desirable or is nearly impossible. The Houghton-Adrian-Palms map unit is organic soils that are severely limited by ponding, wetness, and instability of the organic matter. Extensive drainage is required on the wet soils in the Crosier-Brookston and the Rennselaer-Whitaker map units. The steeper Oshtemo soils in the Oshtemo-Owosso-Fox map unit, the steeper Riddles and Wawasee soils in the Riddles-Metea-Wawasee map unit, and the steeper Plainfield soils in the Plainfield-Chelsea-Tyner map unit have severe limitations for urban development.

The Oshtemo-Owosso-Fox, Plainfield-Chelsea-Tyner, Riddles-Metea-Wawasee, and Martinsville-Riddles map units have many sites that are more suitable for urban uses than other soils in the county. Most of the soils in these map units have fair potential for urban development.

The Rensselaer-Whitaker and Crosier-Brookston map units have good potential for farming but poor potential for nonfarm uses. Although their wetness severely limits nonfarm uses, many of the soils are well suited to farming because they have sufficient artificial drainage for crops.

Most of the soils in the county have good or fair potential for woodland. Commercially valuable trees are most common and generally grow more rapidly on the well drained soils of the Riddles-Metea-Wawasee and Martinsville-Riddles map units than on the wetter soils in other units.

The Oshtemo-Owosso-Fox, Plainfield-Chelsea-Tyner, Riddles-Metea-Wawasee, and Martinsville-Riddles map units have fair potential for parks and intensive recreation areas. Undrained areas in the Houghton-Adrian-Palms map unit are good for wetland nature study. All units provide habitat for many important species of wildlife.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Riddles sandy loam, 6 to 12 percent slopes, eroded, is one of several phases in the Riddles series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Most are too small to be delineated and are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

Ad—Adrian muck, drained. This nearly level, deep, very poorly drained soil is in low areas on till plains or moraines. This soil frequently is ponded for short periods in winter and spring. Areas are irregular in shape and range from 3 to 100 acres in size. The usual size is about 30 acres.

In a typical profile the soil is black, friable muck to a depth of 35 inches. Below this is gray sand to a depth of 60 inches. In many small areas, the muck is more than 51 inches thick or the substratum is marl or loamy material. In some areas the muck immediately above the sandy substratum contains 10 to 40 percent mineral material.

Included with this soil in mapping are some small areas of Wallkill and Washtenaw soils around the outer edges of mapped areas. They make up about 8 percent of the unit.

Permeability of this Adrian soil is moderately slow to moderately rapid in the organic layer and rapid in the sand. Available water capacity is very high. Organic matter content is very high in the surface layer. Runoff is very slow. The seasonal high water table is at or near the surface during winter and early spring.

Most areas of this soil are used for crops. Corn, soybeans, and truck crops are the major crops. Some areas are used for hay or pasture, and a few areas are used for woodland.

If adequately drained, this soil is suitable for corn, soybeans, and specialty crops. This soil is subject to wind erosion and ponding. Also, this soil is wet and warms up slowly in spring. The wetness limits use of equipment and machinery. This soil is very unstable. Use of heavy equipment is hazardous, especially near drainage ditches. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Removing the excess water allows the soil to warm up faster in spring. However, after being drained the muck subsides and becomes susceptible to fire. Wind erosion can be controlled by windbreaks, crop residue management, minimum tillage, stripcropping, cover crops, or a combination of these practices. It can also be controlled by permanent vegetation. Crop residue management,

green manure crops, cover crops, and minimum tillage help to maintain and improve tilth and organic matter content.

If adequately drained, this soil is suited to grasses for hay and pasture. Overgrazing and grazing during wet periods are concerns in management. Overgrazing reduces the density and hardiness of plants. Grazing when the soil is wet causes soil compaction, heaving, and damage to plants by soil movement. Stocking at proper rates, rotating pastures, deferring grazing, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is poorly suited to trees. Equipment limitations, seedling mortality, plant competition, and windthrow hazard are severe because of the wetness and ponding. Undesirable species can be controlled or removed by site preparation or by spraying, cutting, or girdling. Water-tolerant species with deep root systems should be favored. Usually trees can be harvested only during extreme dry seasons or when the ground is frozen.

This soil is generally unsuitable for building sites because of wetness, ponding, caving of cutbanks, low strength, and excess humus. Wetness, ponding, and low strength severely limit use for local roads and streets. The organic material is usually replaced with more stable base material. Elevating the roadbed avoids the wetness. The wetness and ponding also severely limit use of this soil for septic tank absorption fields. Another site should be found.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

AuA—Aubbeenaubbee sandy loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on broad flats on the uplands. Areas are irregularly shaped and range from 3 to 60 acres in size. The usual size is about 10 acres.

In a typical profile the surface layer is grayish brown sandy loam about 8 inches thick. The subsurface layer is brown, mottled sandy loam about 5 inches thick. The subsoil is about 39 inches thick. The upper part of the subsoil is brown, mottled, friable sandy loam; the middle part is light brownish gray, mottled, firm loam; and the lower part is gray, mottled, firm clay loam. The substratum is grayish brown, mottled loam to a depth of 60 inches. In some areas the surface layer and upper part of the subsoil are fine sand. In some places there is less than 15 inches of sandy loam and loam over sandy clay loam or clay loam. In other places the sandy loam material is more than 36 inches thick. In some areas the substratum is stratified with layers of sandy loam and loamy sand.

Included with this soil in mapping are small areas of Crosier, Metea, and Riddles soils. The Crosier soils make up about 5 percent of the unit. The Metea and Riddles soils are on low knolls and ridges and make up about 5 percent of the unit. Also included in swales are areas of a soil that has a mainly gray subsoil; it makes up about 2 percent. About 3 percent of the unit has slopes of more than 2 percent.

Permeability of this Aubbeenaubbee soil is moderate. Available water capacity is high. The organic matter content is low in the surface layer. Surface runoff is slow. The seasonal high water table fluctuates between depths of 1 and 3 feet during winter and early spring. The surface layer is friable and can be tilled through a fairly wide range of moisture content.

Most areas of this soil are farmed. Most adequately drained areas are used for corn, soybeans, and small grains. A few areas are used for hay and pasture.

This soil is suited to corn, soybeans, and small grains. Wetness is a limitation. Subsurface drainage systems have been established in most areas to increase production. Crop residue management and minimum tillage help to maintain and improve tilth and organic matter content.

If adequately drained, this soil is well suited to grasses and legumes for hay and pasture. Deep-rooted legumes such as alfalfa do not grow as well as shallow-rooted crops. Overgrazing or grazing during wet periods causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, grazing at the right times, and restricting use during wet periods reduce surface compaction and help to keep pasture and soil in good condition.

This soil is suited to trees, but only a small acreage is used for woodland. Plant competition is the main concern. Seedlings grow well if competing vegetation is controlled by cutting, spraying, and girdling.

This soil is severely limited for dwellings, mainly by wetness. Artificial drainage removes the excess water; existing field drainage systems need more subsurface lines. Dwellings should be built without basements. Shrinking and swelling of the soil can damage foundations and footings which, however, can be designed to prevent damage. Frost action and wetness severely limit use for local roads and streets. Drainage removes excess water and reduces frost action. Wetness severely limits use for septic tank absorption fields. Drainage is needed.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Bd—Brady sandy loam. This nearly level, deep, somewhat poorly drained soil is on outwash plains. Areas are irregular in shape and range from 5 to 150 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 39 inches thick. The upper part of the subsoil is brown and yellowish brown, mottled, friable sandy loam; the middle part is light brownish gray, mottled, friable sandy loam; and the lower part is light brownish gray, mottled, very friable loamy sand. The substratum is brown, mottled, loose, stratified sand and

coarse sand to a depth of 60 inches. In some small areas the depth to the substratum is less than 40 inches. In a few small areas the surface layer is brown.

Included with this soil in mapping are small areas of Gilford and Oshtemo soils. The Gilford soils are in depressions and undefined drainageways and make up about 5 percent of the unit. The Oshtemo soils are on low knolls and ridges and make up about 5 percent of the unit.

Permeability of this Brady soil is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate to high in the surface layer. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet during winter and early spring.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for hay, pasture, or woodland. Potential for crops is fair.

This soil is suited to corn, soybeans, and small grains. Wetness is the main limitation. If the soil is adequately drained, row crops can be grown most of the time. An adequate drainage system allows the soil to warm up soon enough in spring for early plowing and planting. Minimum tillage, crop residue management, and cover crops help to maintain and improve tilth and organic matter content and control wind erosion.

If adequately drained, this soil is well suited to grasses and legumes for hay or pasture. Pasture reduces wind erosion. Because of the wetness, deep-rooted legumes such as alfalfa do not grow well. Overgrazing and grazing during wet periods cause surface compaction and poor tilth. Overgrazing reduces density and hardiness of plants, and overgrazed areas are subject to wind erosion. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet and very dry periods help to keep pasture and soil in good condition.

This soil is suited to trees, but only a few areas are used for woodland. Equipment limitations and plant competition are moderate. Seedlings survive and grow well if competing vegetation is controlled by site preparation, spraying, cutting, or girdling.

Wetness severely limits use of this soil for building sites. An adequate drainage system lowers the water table. Buildings should be constructed without basements. Frost action severely limits use for local roads and streets. Drainage ditches along the roads lower the water table and reduce frost action. The wetness and poor filtering qualities of the soil severely limit use for septic tank absorption fields. Effluent from the septic tank could seep into the ground water.

This soil is in capability subclass IIw and woodland suitability subclass 3s.

BeA—Brems sand, 0 to 2 percent slopes. This nearly level, deep, moderately well drained soil is on broad flats and low knolls and in swales. Areas are irregular in shape and range from 3 to about 60 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark brown sand about 8 inches thick. The subsurface layer is brown sand about 6 inches thick. The subsoil is about 34 inches thick. The upper part of the subsoil is yellowish brown and light yellowish brown, mottled, loose sand; and the lower part is strong brown, mottled sand. The substratum is light yellowish brown, mottled sand to a depth of 60 inches. In some small areas this soil has a sandy loam subsoil or has gray colors in the lower part.

Included with this soil in mapping are some small areas of Plainfield and Tyner soils on low ridges and knolls. They make up about 10 percent of the unit.

Permeability of this Brems soil is rapid. Available water capacity is low. The organic matter content is moderate in the surface layer. Runoff is slow or very slow. The seasonal high water table is at a depth of 2 to 3 feet. The surface layer is very friable and has good tilth.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the major crops. Many small areas of this soil are used for woodland. Some areas are used for hay and pasture. Potential for crops is fair.

This soil is suited to corn, soybeans, and small grains. Insufficient moisture in summer causes this soil to become droughty. Wind erosion can be controlled by windbreaks, proper use of crop residue, minimum tillage, stripcropping, cover crops, or a combination of these practices. It also can be controlled by permanent vegetation. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suitable for grasses and legumes for hay and pasture. The low available water capacity is a limitation. Hay and pasture reduce wind erosion. Overgrazing reduces density and hardiness of plants, and overgrazed areas are subject to wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Pine usually does better in this soil than hardwoods.

Wetness severely limits use of this soil for dwellings with basements. Use for building sites is also severely limited by caving of cutbanks and high corrosivity to concrete. An adequate drainage system lowers the water table. Basement walls can be specially treated to retard corrosion. Use for local roads and streets is moderately limited. Wetness and poor filtering qualitites of the soil severely limit use for septic tank absorption fields. Drainage around the filter field will lower the water table. Because the soil is rapidly permeable, effluent from the septic tank may contaminate ground water.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

BoA—Bronson loamy sand, 0 to 2 percent slopes. This nearly level, deep, moderately well drained soil is on outwash plains. Areas are irregular in shape and range from 5 to 250 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsurface layer is brown loamy sand about 4 inches thick. The subsoil is about 32 inches thick. The upper part of the subsoil is brown, friable sandy loam; the middle part is brown, mottled, friable sandy loam; and the lower part is light brownish gray and dark yellowish brown, mottled, very friable loamy sand. The substratum is light brownish gray, mottled, stratified coarse sand and fine gravelly sand to a depth of 60 inches. In some small areas the depth to the substratum is less than 40 inches. In some small areas the surface layer is very dark grayish brown and mottles are present just below the plow layer. In some small areas, clay content increases below the stratified sand in the substratum.

Included with this soil in mapping are small areas of Oshtemo and Pinhook soils. The Oshtemo soils are on low knolls and ridges and make up about 5 percent of the unit. The Pinhook soils are in lower positions and make up about 3 percent of the unit.

Permeability of this Bronson soil is moderately rapid in the subsoil and very rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet during winter and early spring.

Most areas of this soil are farmed. Some areas are used for corn, soybeans, and small grains. Some areas are used for hay and pasture, and some areas are used for woodland. Potential for crops is fair.

This soil is suited to corn, soybeans, and small grains. Wetness is the main limitation. If the soil is adequately drained, row crops can be grown most of the time. An adequate drainage system helps the soil to warm up soon enough in spring for early plowing and planting. Minimum tillage, crop residue management, and cover crops help to maintain and improve tilth and organic matter content and control wind erosion.

If adequately drained, this soil is well suited to grasses and legumes for hay or pasture. Pasture reduces wind erosion. Because of the wetness, deep-rooted legumes such as alfalfa do not grow well. The major concerns of management are overgrazing and grazing when the soil is wet. Overgrazing reduces the density and hardiness of plants, and overgrazed areas are subject to wind erosion. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet and very dry periods help to keep pasture and soil in good condition.

This soil is suited to trees, but only a few areas are used for woodland. Plant competition and seedling mortality are moderate. Seedlings survive and grow well if competing vegetation is controlled by site preparation, spraying, cutting, or girdling.

This soil is moderately limited for buildings without basements and severely limited for houses with basements. An adequate drainage system lowers the water table. Frost action severely limits use for local roads and streets. Drainage along the road reduces frost action. Wetness and poor filtering qualities of the soil severely limit use for septic tank absorption fields. An adequate drainage system lowers the water table, but effluent from the septic tank may contaminate the ground water.

This soil is in capability subclass IIs and woodland suitability subclass 3s.

Br—Brookston loam. This nearly level, deep, very poorly drained soil is on broad flats, in swales, and along drainageways on the upland till plains and moraines. This soil is frequently ponded for brief periods by runoff from surrounding soils. Areas are large and irregular in shape and range from 3 to 350 acres in size. The usual size is about 65 acres.

In a typical profile the surface layer is very dark gray loam about 14 inches thick. The subsoil is about 34 inches thick. The upper part of the subsoil is dark gray and gray, mottled, firm clay loam; and the lower part is light gray and dark gray, mottled, firm silty clay loam and clay loam. The substratum is brown loam to a depth of 60 inches. In a few small areas this soil is silty clay loam to a depth of 40 inches. In a few small areas stratified loamy material is in the lower part of the subsoil. In some areas lighter colored material has been deposited on the original black surface layer. In some areas the surface layer is mucky loam.

Included with this soil in mapping are small areas of Aubbeenaubbee, Crosier, and Whitaker soils on swells. These soils make up about 10 percent of the map unit.

Permeability of this Brookston soil is moderate. Available water capacity is high. The organic matter content is high in the surface layer. Surface runoff is very slow to ponded. The seasonal high water table is often at or near the surface between December and May. The surface layer becomes hard and cloddy if tilled while wet.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Few areas are used for hay or pasture. Some areas that are more difficult to drain adequately remain in woodland.

This soil is well suited to crops. Wetness is the main limitation. Artificial drainage and waterways are needed if the soil is cultivated. Crop residue management and minimum tillage maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. Drainage is necessary for good production. Deep-rooted legumes such as alfalfa do not grow as well as shallow-rooted legumes. Overgrazing or grazing

during excessively wet periods causes surface compaction and poor tilth. Overgrazing also reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is suited to trees. Equipment limitations, seedling mortality, and plant competition are severe. Windthrow hazard is moderate. Seedlings survive and grow best if competing vegetation is controlled and the soil has been drained. Undesirable trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling. Trees can usually be harvested only during extremely dry seasons or when the ground is frozen. Water-tolerant species should be favored.

Ponding severely limits use of this soil for building sites. Building sites must be artificially drained and protected from ponding. Suitable outlets for drainage are usually difficult to find. Dwellings should be constructed without basements. Ponding, low strength, and frost action severely limit use for local roads and streets. The road base can be strengthened with more suitable material. Ditches along the road lower the water table and reduce frost action. Because of the ponding, this soil is severely limited and generally unsuitable for septic tank absorption fields.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

ChB—Chelsea fine sand, 2 to 6 percent slopes. This gently sloping, deep, excessively drained soil is on low knolls on outwash plains. Areas are irregular in shape and range from 3 to about 40 acres in size. The usual size is about 10 acres.

In a typical profile the surface layer is dark brown fine sand about 7 inches thick. The subsurface layer is about 27 inches thick. It is dark brown fine sand in the upper part and yellowish brown fine sand in the lower part. To a depth of 80 inches, the subsoil is light yellowish brown, loose fine sand with bands of dark brown and dark yellowish brown very friable loamy sand. Loamy sand bands are not present in some areas. In some areas the sand is mostly medium and coarse.

Included with this soil in mapping are some small areas of Brems, Metea, and Oshtemo soils. The Brems soils are in swales and make up about 3 percent of the unit. The Metea and Oshtemo soil make up about 11 percent of the unit.

Permeability of this Chelsea soil is rapid. Available water capacity is low. The organic matter content is moderate in the surface layer. Runoff is slow.

Most areas of this soil are used for hay and pasture. Some small areas are used for crops. Corn, soybeans, sorghum, and small grains are the major crops.

This soil is poorly suited to cultivated crops. Droughtiness is the main limitation. Wind erosion is also a limitation. It can be controlled by windbreaks, crop residue, minimum tillage, stripcropping, cover crops, or a combination of these practices. It can also be controlled by permanent vegetation. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay and pasture. Droughtiness is the main limitation. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Hay and pasture reduce wind erosion. Overgrazing reduces plant density and hardiness, and overgrazed areas are subject to wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer help to reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is moderate because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Pine usually do better than hardwoods in this soil because of their deep roots.

This soil is only slightly limited for building sites. Basements can be coated with material that retards corrosion of concrete. This soil is slightly limited for local roads and streets. The soil's poor filtering qualities severely limit use for septic tank absorption fields. Because the soil is rapidly permeable, effluent from the septic tank may contaminate the ground water.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

ChC—Chelsea fine sand, 6 to 12 percent slopes. This moderately sloping, deep, excessively drained soil is on ridges, knolls, and side slopes on outwash plains. Areas are mostly long and narrow and range from 3 to about 35 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark brown fine sand about 6 inches thick. The subsurface layer is light yellowish brown fine sand about 24 inches thick. To a depth of 80 inches, the subsoil is light yellowish brown, loose fine sand with bands of dark brown, very friable loamy sand. In some areas the loamy sand bands are not present and the soil is dominantly sand and coarse sand or is dominantly loamy sand.

Included with this soil in mapping are some small areas of Brems, Metea, and Oshtemo soils. The Brems soils are in swales and make up about 2 percent of the unit. The Metea and Oshtemo soils make up about 11 percent of the unit.

Permeability of this Chelsea soil is rapid. Available water capacity is low. The organic matter content is moderate in the surface layer. Runoff is slow.

Most areas of this soil are used for hay and pasture. Some small areas are used for crops. Corn, soybeans, and small grains are the major crops. Some small areas are used for woodland.

This soil is poorly suited to cultivated crops. Droughtiness is the main limitation. Wind erosion is also a limitation. It can be controlled by windbreaks, crop

residue, minimum tillage, stripcropping, cover crops, or a combination of these practices. It can also be controlled by permanent vegetation. Minimum tillage, crop residue management, green manure crops, manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay and pasture. Because of this soil's droughtiness, deep-rooted legumes and drought-tolerant grasses are best suited. Hay and pasture reduce wind and water erosion. Overgrazing reduces plant density and hardiness, and overgrazed areas are subject to wind and water erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer help to reduce wind and water erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is moderate because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Pines usually do better in this soil because of their deep roots. Properly designing access roads reduces erosion.

Slope moderately limits use of this soil for building sites. In addition, concrete may corrode and cutbanks may cave in. The slope can be modified by land leveling. Slope also moderately limits use for local roads and streets. The land can be leveled, or the roads can be constructed on the contour. The poor filtering qualities of the soil severely limit use for septic tank absorption fields. Because this soil is rapidly permeable, effluent from the septic tank may contaminate the ground water.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

CtA—Crosier loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on broad flats on the uplands. Areas are irregular in shape and range from 3 to 300 acres in size. The usual size is about 30 acres.

In a typical profile the surface layer is dark grayish brown loam about 9 inches thick. The subsurface layer is grayish brown loam about 3 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is grayish brown, mottled, firm clay loam; and the lower part is brown, mottled, firm clay loam. The substratum is calcareous, brown loam to a depth of 60 inches. In some small areas the lower part of the subsoil is stratified. In some small areas the subsoil is mostly gray.

Included with this soil in mapping are a few small areas of Brookston and Rensselaer soils. These soils are in swales and make up about 10 percent of the unit. Also included are some areas of soils that have loamy sand surface and subsurface layers.

Permeability of this Crosier soil is moderately slow. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is slow. The seasonal high water table fluctuates between depths of 1 and 3 feet during winter and early spring. The surface layer is friable and easily tilled.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for pasture, and other areas are used for woodland.

If drained, this soil is suited to corn, soybeans, and small grains. Wetness is the main limitation. Subsurface drainage systems have been established in most areas. Where drained, this soil warms up soon enough in spring for early plowing and planting. Working this soil when it is wet causes compaction. Minimum tillage, crop residue management, and cover crops help to maintain and improve tilth and organic matter content.

If adequately drained, this soil is suited to grasses and legumes for hay and pasture. Deep-rooted legumes such as alfalfa do not grow as well as shallow-rooted plants. Grazing during excessively wet periods causes surface compaction and poor tilth. Overgrazing reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is suitable for trees, but only a small acreage is used for woodland. Plant competition is moderate because of wetness. Seedlings survive and grow well if competing vegetation is controlled by cutting, spraying, and girdling.

Wetness severely limits use of this soil for building sites. An adequate drainage system lowers the water table sufficiently for building sites, but pumping may be necessary if drainage outlets are not available. Frost action and low strength severely limit use for local roads and streets. Road ditches lower the seasonal high water table and reduce frost action. Strengthening the base material helps to overcome the low strength. Wetness and slow permeability severely limit use for septic tank absorption fields. An alternate site should be found.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Ed—Edwards muck, drained. This nearly level, deep, very poorly drained soil is in low areas on till plains of moraines. This soil is frequently ponded for short periods in winter and spring. Areas are irregular in shape and range from 3 to 120 acres in size. The usual size is about 12 acres.

In a typical profile the surface layer is black muck about 9 inches thick. The next layer is black, friable muck over dark reddish brown, friable muck that extends to a depth of 20 inches. The substratum to a depth of 60 inches is light brownish gray marl. In some small areas there is less than 16 inches of muck over the marl. In some small areas strata of coprogenous earth about 5 inches thick are below a depth of 30 inches. In some places the underlying material is loamy or sandy. In some areas the organic material is more than 51 inches thick.

Included with this soil in mapping are some small areas of Wallkill and Washtenaw soils, mainly around the

edges of mapped areas. They make up about 8 percent of the unit.

Permeability of this Edwards soil is moderately rapid in the organic layer and variable in the marl. Available water capacity is very high. The organic matter content is very high in the surface layer. Runoff is very slow. The seasonal high water table is less than 12 inches below the surface and is frequently at the surface during winter and early spring.

Most areas of this soil are farmed. Most areas are used for corn, and some are used for soybeans.

If adequately drained, this soil is suitable for corn, soybeans, and specialty crops. This soil is subject to wind erosion and ponding. Also, this soil is wet and warms up slowly in spring. The ponding hinders use of equipment, and machinery bogs down. The soil is very unstable. Use of heavy equipment is hazardous, especially near drainage ditches. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Removing excess water also allows the soil to warm up faster in spring. However, after being drained the muck subsides and becomes susceptible to fire. Wind erosion can be controlled by windbreaks, crop residue management, minimum tillage, stripcropping, cover crops, or a combination of these practices. It can also be controlled by permanment vegetation. Crop residue managment, green manure crops, cover crops, and minimum tillage help to maintain or improve tilth and organic matter content.

If adequately drained, this soil is suited to grasses for hay and pasture. The main concerns are overgrazing and grazing during wet periods. Overgrazing reduces plant density and hardiness. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is poorly suited to trees. Equipment limitations, seedling mortality, plant competition, and windthrow hazard are severe because of wetness and ponding. Undesirable vegetation can be controlled or removed by site preparation, spraying, cutting, or girdling. Water-tolerant species should be favored. Trees can generally be harvested only during extremely dry seasons or when the ground is frozen.

This soil is severely limited and generally unsuitable for building sites because of ponding, low strength, and excess humus. Wetness, ponding, and low strength severely limit use for local roads and streets. The organic material and marl can be replaced with more suitable material. Elevating the roadbed avoids the wetness. This soil is generally unsuitable for septic tank absorption fields because of wetness, ponding, and permeability of the underlying marl. Alternate sites should be found.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

EsA—Elston sandy loam, 0 to 2 percent. This nearly level, deep, well drained soil is on broad glacial outwash plains. Areas are broad and irregular in shape and range from I5 to 240 acres in size. The usual size is about 80 acres.

In a typical profile the surface layer is black and very dark grayish brown sandy loam about I4 inches thick. The subsoil is about 39 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam; the middle part is dark brown, friable gravelly sandy loam; and the lower part is dark brown, very friable gravelly loamy sand. The substratum is brown, stratified coarse sand and gravelly sand to a depth of 60 inches. In some small areas the subsoil and underlying material contain little or no gravel. In some areas there is more clay in the surface layer and subsoil. A few areas have slopes of more than 2 percent.

Included with this soil in mapping are small areas of Oshtemo and Troxel soils. The Oshtemo soils are sloping. The Troxel soils are in potholes. These soils make up about I2 percent of the unit.

Permeability of this Elston soil is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is moderate. The organic matter content is high in the surface layer. Surface runoff is slow. The surface layer is friable and has good tilth.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for hay and pasture.

This soil is suited to corn, soybeans, and small grains. The moderate available water capacity is the main limitation. Green manure crops, minimum tillage, crop residue management, additions of manure, and cover crops help to maintain and improve organic matter content and maintain tilth.

The soil is suited to grasses and legumes for hay or pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is not rated for woodland because trees are not native to this prairie soil. This soil is suitable for windbreaks.

This soil is only slightly limited for building sites and local roads and streets. The poor filtering qualities of the soil severely limit use for septic tank absorption fields. Because this soil is very rapidly permeable, effluent from the septic tank could contaminate the ground water.

This soil is in capability subclass IIs. This soil was not placed in a woodland suitability subclass.

Fc—Fluvaquents, loamy. These nearly level, deep, somewhat poorly drained soils are on bottom lands. They are frequently flooded for brief periods in early spring. Areas are irregular in shape and range from 3 to 250 acres in size. The usual size is about 20 acres.

In a representative area of Fluvaquents, the surface layer is dark grayish brown sandy loam. The substratum is multicolored, mottled loamy and sandy material. In some small areas the upper part of the soil has no gray mottles. In some areas the surface layer is fine sandy loam. In many areas the subsoil is mostly gray.

Included with Fluvaquents in mapping are areas of Stonelick soils. The Stonelick soils are in higher positions and make up about 8 percent of the unit. Also included are some depressional areas of soils that have an organic surface layer; they make up about 12 percent. Some areas are under water for most of the year.

Permeability of Fluvaquents is moderately rapid. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 3 feet during winter and spring. The surface layer is friable and easily tilled.

Most areas of these soils are not farmed and are not suitable for farming because drainage is infeasible. A few small areas are used for pasture. Much of the acreage is wooded.

These soils are poorly suited to corn, soybeans, and small grains. Wetness and flooding are the main limitations. These soils are in low positions, and areas are small and scattered.

These soils are poorly suited to trees, although a large acreage is wooded. Plant competition, equipment limitations, windthrow hazard, and seedling mortality are all problems. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation, spraying, cutting, or girdling. Trees can usually be harvested only when the ground is frozen. Water tolerant species should be favored.

These soils are severely limited and generally unsuited for building sites because of flooding and wetness. Flooding and frost action severely limit use for local roads and streets. Lowering the water table and removing floodwaters requires drainage ditches and a pumping system. Drainage also reduces frost action. These soils are generally unsuitable for septic tank absorption fields because of the flooding. A more suitable site should be found.

These soils are in capability subclass Vw. These soils were not placed in a woodland suitability subclass.

FsA—Fox sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad flat uplands. It is moderately deep over sand or gravelly sand. Areas are irregular in shape and range from 5 to about 70 acres in size. The usual size is about 25 acres.

In a typical profile the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The subsoil is dark brown, firm clay loam and gravelly clay loam about 23 inches thick. The substratum is brown gravelly sand to a depth of 60 inches. In some small areas the depth to the substratum is more than 40 inches. In small areas this soil has less clay in the subsoil.

Included with this soil in mapping are small areas of Bronson and Elston soils. The Bronson soils are in swales and make up about 3 percent of the unit. The Elston soils make up about 5 percent of the unit.

Permeability of this Fox soil is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate or high in the surface layer. Runoff is slow. The upper part of this soil is slightly acid or medium acid.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the major crops. Some small areas are used for hay and pasture or for woodland. Some areas are mined for sand and gravel.

This soil is well suited to cultivated crops. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or trampling by livestock during wet periods reduces density and hardiness of plants, reduces forage yields, damages the sod, and causes surface compaction and poor tilth. Stocking at proper rates, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction. These practices, as well as strip-grazing and rotational grazing, help to maintain a dense cover of hardy plants and keep pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled by spraying, cutting, or girdling.

Shrinking and swelling moderately limit use of this soil for building sites. Properly designing foundations and footings helps to prevent damage. Frost action and shrinking and swelling moderately limit use for local roads and streets; the base material can be strengthened. The poor filtering qualities of the soil severely limit its use for septic tank absorption fields. Because the substratum is rapidly permeable, effluent from the septic tank may contaminate the ground water.

This soil is in capability subclass IIs and woodland suitability subclass 2o.

FsB—Fox sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on knolls on the uplands. It is moderately deep over sand and gravelly sand. Areas are irregular in shape and range from 5 to about 45 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The subsoil is dark brown, firm clay loam and gravelly clay loam about 23 inches thick. The substratum is brown gravelly sand to a depth of 60 inches. In some small

areas, depth to the substratum is more than 40 inches. In a few small areas the subsoil has less clay.

Included with this soil in mapping are small areas of Brady and Bronson soils. The Brady and Bronson soils are in swales and make up about 8 percent of the unit.

Permeability of this Fox soil is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Runoff is medium. The upper part of this soil is slightly acid or medium acid.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the major crops. Some small areas are used for hay, pasture, or woodland. Some areas are mined for sand and gravel.

This soil is well suited to cultivated crops. Erosion can be controlled by terraces and diversions, contour strips, stripcropping, cover crops, grassed waterways, minimum tillage, crop residue management, crop rotation, and grade stabilization structures. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or trampling by livestock during wet periods reduces density and hardiness of plants, reduces forage yields, damages the sod, causes surface compaction and poor tilth, and allows erosion. Stocking at proper rates, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction. These practices, as well as strip-grazing and rotational grazing, help to maintain a dense cover of hardy plants, reduce erosion, and keep pasture and soil in good condition.

This soil is well suited to trees. If necessary, unwanted trees and shrubs can be controlled by site preparation, spraying, and girdling.

Shrinking and swelling moderately limits use of this soil for building sites. Slope and shrinking and swelling moderately limit use for small commercial buildings. Cutbank caving is a severe limitation. Properly designing foundations and footings helps to prevent damage caused by shrinking and swelling. The slope can be modified by leveling. Frost action and shrinking and swelling moderately limit use for local roads and streets; the base material can be strengthened. The soil's poor filtering qualities severely limit use for septic tank absorption fields. Because the substratum is rapidly permeable, effluent could contaminate the ground water.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

FsC2—Fox sandy loam, 6 to 12 percent slopes, eroded. This moderately sloping, well drained soil is on back and side slopes on the uplands. It is moderately deep over sand and gravelly sand. Areas are irregular in shape and usually small.

In a typical profile the surface layer is dark grayish brown sandy loam about 7 inches thick. The subsoil is dark brown, firm clay loam and gravelly clay loam about 23 inches thick. The substratum is brown gravelly sand to a depth of 60 inches. In some small areas, the depth to the substratum is less than 24 inches. In small areas, the subsoil has less clay.

Included with this soil in mapping are small areas of Brady, Bronson, Chelsea, and Riddles soils. The Brady and Bronson soils are in swales and make up about 2 percent of the unit. The Chelsea and Riddles soils make up about 8 percent. Also included are knolls on which the subsoil has been exposed by erosion and some areas having slopes of more than 12 percent; they make up less than 2 percent of the unit.

Permeability of this Fox soil is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Runoff is medium. The upper part of this soil is slightly acid or medium acid.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the major crops. Some small areas are used for hay, pasture, or woodland. Some areas are mined for sand and gravel.

This soil is suitable for cultivated crops. Erosion can be controlled by terraces and diversions, contour strips, stripcropping, cover crops, grassed waterways, minimum tillage, crop residue management, crop rotation, and grade stabilization structures. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suitable for grasses and legumes for hay and pasture. Overgrazing or trampling by livestock during wet periods reduces density and hardiness of plants, reduces forage yields, damages the sod, causes surface compaction and poor tilth, and allows erosion. Stocking at proper rates, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction. These practices, as well as strip-grazing and rotational grazing, help to maintain a dense cover of hardy plants, reduce erosion, and keep pasture and soil in good condition.

This soil is well suited to trees. If necessary, unwanted trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling.

Slope and shrinking and swelling moderately limit use of this soil for building sites. The slope can be modified by leveling. Properly designing footings and foundations prevents damage caused by shrinking and swelling. Slope, frost action, and shrinking and swelling moderately limit use for local roads and streets. The roadbed can be strengthened with suitable base material. This soil is severely limited for septic tank absorption fields. Because the substratum is rapidly permeable, effluent from the septic tank could contaminate the ground water.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

Gf—Gilford sandy loam. This nearly level, deep, very poorly drained soil is on broad glacial outwash plains. It is frequently ponded for brief periods by runoff from surrounding soils. Areas are irregular in shape and range from 5 to 450 acres in size. The usual size is about 25 acres.

In a typical profile the surface layer is black sandy loam about 14 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is dark gray, friable sandy loam; and the lower part is grayish brown, mottled, very friable loamy sand. The substratum is gray sand to a depth of 60 inches. In some areas the surface layer and subsoil are loamy sand. In some other small areas the surface layer is loam. In some small areas the upper part of the surface layer has large amounts of organic matter.

Included with this soil in mapping are small areas of Brady, Pinhook, and Rensselaer soils. The Brady and Pinhook soils are on the slightly higher positions and make up about 8 percent of the unit. Rensselaer soils are in depressions and make up about 5 percent.

Permeability of this Gilford soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The organic matter content is high in the surface layer. Surface runoff is very slow or ponded. The seasonal high water table is at or near the surface during a significant part of the year. The surface layer is friable and has good tilth.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. A few areas are used for pasture or woodland.

This soil is suited to corn, soybeans, and small grains. Wetness is the main limitation. Artificial drainage is necessary for crop production. Nearly all areas of this soil have some type of drainage system. A suitable drainage system is difficult to establish in some areas because adequate outlets are not available. If a suitable controlled drainage system is established, row crops can be grown most of the time. Minimum tillage, crop residue management, and cover crops help to maintain organic matter content and good tilth.

This soil is suited to grasses and legumes for hay or pasture. Drainage is necessary for high yields. Because of the wetness, deep-rooted legumes such as alfalfa do not grow well. Overgrazing during wet periods causes surface compaction and poor tilth. Overgrazing also reduces density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is poorly suited to trees. Only a few areas are used for woodland. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe because of wetness and ponding. Unwanted trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling. Water-tolerant species should be favored. Trees can usually be harvested only during dry seasons or when the ground is frozen.

Ponding severely limits use of this soil for building sites. Drainage is difficult in most areas because this soil is often in the lowest part of the landscape. Pumping overcomes this problem. Frost action and ponding severely limit use for local roads and streets. Drainage ditches along the road lower the water table and reduce frost action. Elevating the roadbed avoids the wetness. Ponding and the soil's poor filtering qualities severely limit use for septic tank absorption fields. Effluent from the septic tank could seep into the ground water.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

HdB—Hillsdale sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on moraines. Areas are irregularly shaped and range from 5 to 70 acres in size. The usual size is about 14 acres.

In a typical profile the surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 36 inches thick. The upper part of the subsoil is dark yellowish brown, friable sandy loam; the middle part is yellowish brown, friable sandy clay loam; and the lower part is brown and yellowish brown, friable sandy loam. The underlying material is brown sandy loam to a depth of 60 inches. Some small areas have slopes of less than 2 percent or more than 6 percent. In some small areas the subsoil contains more than 15 percent gravel. In some areas the subsoil contains more than 10 inches of sandy clay loam or clay loam.

Included with this soil in mapping are a few small areas of Aubbeenaubbee and Crosier soils in swales. They make up about 10 percent of the unit. Some areas have a few stones and boulders that interfere with cultivation.

Permeability of this Hillsdale soil is moderate. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is friable and has good tilth.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for hay and pasture. A few areas are in orchards and trees.

This soil is suited to corn, soybeans, and small grains. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive erosion and runoff. Crop residue management and cover crops also help to control erosion and maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. Hay or pasture reduce wind and water erosion. Overgrazing and grazing during excessively wet periods cause surface compaction, excessive runoff, and poor tilth. Overgrazing also reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is well suited to trees. A few small areas remain in trees. Plant competition is the main problem. Seedlings survive and grow well if competing vegetation is controlled by site preparation, spraying, cutting, or girdling.

This soil is only slightly limited for building sites. Frost action moderately limits use for local roads and streets. The base material can be strengthened or replaced and road ditches can be installed. The soil's permeability moderately limits use for septic tank absorption fields; the field can be enlarged.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

Ho—Houghton muck, drained. This nearly level, deep, very poorly drained soil is in low areas on till plains or moraines. This soil is frequently ponded for short periods in winter and spring. All areas of this soil are artificially drained. Areas are generally round and elongated in shape and range from 5 to 350 acres in size. The usual size is about 25 acres.

In a typical profile the surface layer is black muck about 9 inches thick. Below this, the soil is black, friable muck to a depth of 60 inches. In some small areas strata of coprogenous earth about 3 inches thick are below a depth of 30 inches. In some areas a substratum of loamy, sandy, or marly material is at a depth of less than 5l inches. In some places the soil contains strata of mucky peat less than 5 inches thick.

Included with this soil in mapping are small areas of Wallkill soils around the edge of some mapped areas; they make up about 4 percent of the unit. Also included are some small areas of very strongly acid soils that have not been drained and are used mostly for trees; they make up about 5 percent of the unit.

Permeability of this Houghton soil is moderately slow to moderately rapid. Available water capacity is very high. Surface runoff is very slow. The seasonal high water table is frequently at the surface during winter and early spring. The surface layer is friable and has good tilth.

Most areas of this soil are used for crops. Corn is the major crop. Some areas are used for soybeans, some are used for pasture, and some are used for specialty crops.

If adequately drained, this soil is suitable for corn, soybeans, and specialty crops. This soil is subject to wind erosion and ponding. Also, this soil is wet and warms up slowly in spring. The ponding hinders use of equipment, and machinery bogs down. This soil is very unstable. Use of heavy equipment is hazardous, especially near drainage ditches. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Removing the excess water allows the soil to warm up faster in spring. However, after being drained the muck subsides and becomes susceptible to fire. Wind erosion can be controlled by windbreaks, crop residue management, minimum tillage, stripcropping, cover crops, or a combination of these practices. It can also be controlled by permanent vegetation. Crop residue management, green manure crops, cover crops, and minimum tillage help to maintain and improve tilth and organic matter content.

If adequately drained, this soil is suited to grasses for hay and pasture. The main concerns are overgrazing and grazing during wet periods. Overgrazing reduces density and hardiness of plants. Grazing when the soil is wet causes soil compaction, heaving, and damage to plants by soil movement. Stocking at proper rates, rotating pastures, deferring grazing at proper times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is poorly suited to trees. Equipment limitations, seedling mortality, plant competition, and windthrow hazard are severe because of the wetness and ponding. Undesirable vegetation can be controlled or removed by site preparation, spraying, cutting, or girdling. Water-tolerant species should be favored. Trees can generally be harvested only during extremely dry seasons or when the ground is frozen.

This soil is severely limited and generally unsuitable for building sites because of ponding and low strength. Ponding and low strength also severely limit use for local roads and streets. The organic material can be replaced with more stable base material. Elevating the roadbed avoids the wetness. This soil is generally unsuitable for septic tank absorption fields because of ponding and permeability. Another site should be found.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

Hp—Houghton muck, ponded. This nearly level, deep, very poorly drained, organic soil is on moraines and outwash plains. This soil is generally covered by shallow water most of the year; in some years it is continually covered. Areas are generally round or elongated in shape and range from 3 to 250 acres in size. The usual size is 7 acres.

In a typical profile the surface layer is black muck about 5 inches thick. It is decomposed organic matter with many roots of water-loving plants. Below this the soil is black muck to a depth of 60 inches. In some areas mineral material has been washed over the muck from higher surrounding soils.

Included with this soil in mapping are small areas of Adrian, Edwards, and Palms soils around the edge of mapped areas. They make up less than 5 percent of the unit

Most areas of this soil are not farmed. They are covered with aquatic and semiaquatic vegetation such as cattails, rushes, sedges, waterlilies, pondweed, duckweed, spatterdock, and water-tolerant trees and shrubs. This soil is well suited to wetland wildlife habitat and poorly suited to all other uses.

This soil is used as habitat for wetland wildlife. It provides cover, nesting, and food for many aquatic

animals, including duck, geese, and other birds. Areas of this soil produce fur, fish, wildlife, and other products.

Most areas of this soil recharge the ground water. They also moderate water flow and provide natural flood control. This soil helps to purify water by trapping, filtering, and storing sediment and other pollutants and by recycling nutrients. However, this soil is fragile and is easily damaged by misuse.

This soil is generally unsuitable for building sites, local roads and streets, and septic tank absorption fields. The ponding is extremely difficult to overcome because this soil is in the lowest parts of the landscape and receives water from all surrounding soils. For local roads and streets, the organic material can be replaced with more stable base material. Elevating the roadbed avoids the wetness.

This soil is in capability subclass VIIIw and woodland suitability subclass 5w.

LnA—Linkville sandy loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on broad undulating ground moraines or outwash plains. Areas are irregularly shaped and range from 5 to 400 acres in size. The usual size is about 35 acres.

In a typical profile the surface layer is very dark brown and very dark grayish brown sandy loam about 13 inches thick. The subsoil is about 64 inches thick. The upper part of the subsoil is dark brown, friable loam; the middle part is yellowish brown, firm or friable loam; and the lower part is dark brown, friable gravelly sandy loam. The substratum is stratified calcareous sand and gravelly sand to a depth of 80 inches. In some small areas the depth to calcareous gravelly sand is less than 48 inches. In some areas the subsoil contains more sand.

Included with this soil in mapping are areas of Riddles and Troxel soils. The Riddles soils are on high knolls and make up about 4 percent of the unit. The well drained Troxel soils are in small depressions and make up about 5 percent. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Linkville soil is moderate in the subsoil and rapid in the substratum. Available water capacity is high. The organic matter content is high in the surface layer. Surface runoff is slow. The surface layer is friable and has good tilth.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some small areas are used for hay and pasture.

The soil is suited to corn, soybeans, and small grains. Minimum tillage, green manure crops, manure, crop residue management, and cover crops help to maintain and improve organic matter content, maintain tilth, and reduce wind erosion.

This soil is well suited to grasses and legumes for hay and pasture, which reduce wind erosion. Overgrazing and grazing during excessively wet periods cause surface compaction and poor tilth. Overgrazing also reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring of grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is not rated for woodland because most of the trees on this prairie soil were planted for windbreaks.

Shrinking and swelling moderately limits use of this soil for building sites. Properly designing footings and foundations helps to prevent damage. Low strength severely limits use for local roads and streets; the road base can be strengthened with more suitable material. The permeability moderately limits use for septic tank absorption fields. The field can be enlarged.

This soil is in capability class I. This soil was not placed in a woodland suitability subclass.

LnB—Linkville sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on broad undulating ground moraines or outwash plains. Areas are irregularly shaped and range from 3 to 30 acres in size.

In a typical profile the surface layer is very dark brown and very dark grayish brown sandy loam about 10 inches thick. The subsoil is about 54 inches thick. The upper part of the subsoil is dark brown, friable loam; the middle part is yellowish brown, firm or friable loam; and the lower part is dark brown, friable gravelly sandy loam. The substratum is calcareous gravelly sand to a depth of 70 inches. In some small areas the depth to calcareous gravelly sand is less than 48 inches. In some areas the subsoil contains more sand.

Included with this soil in mapping are areas of Riddles and Troxel soils; they make up about 10 percent of the unit. The Riddles soils are on high knolls, and Troxel soils are in depressions. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Linkville soil is moderate in the subsoil and rapid in the underlying substratum. Available water capacity is high. Organic matter content is high in the surface layer. Surface runoff is medium. The surface layer is friable and has good tilth.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some small areas are used for hay and pasture.

This soil is suited to corn, soybeans, and small grains. Erosion and surface runoff limit use for row crops. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures reduce erosion. Crop residue management, green manure crops, additions of manure, and cover crops also reduce erosion and help to maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay and pasture, which reduce wind and water erosion. Overgrazing and grazing during excessively wet periods cause surface compaction, excessive runoff, and poor tilth. Overgrazing also reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is not rated for woodland because most of the trees on this soil were planted for windbreaks.

Slope and shrinking and swelling moderately limit use of this soil for building sites. Properly designing footings and foundations helps to prevent damage caused by shrinking and swelling. The slope can be modified by grading. Low strength severely limits use for local roads and streets. The road base can be strengthened with more suitable material. The moderate permeability of the subsoil moderately limits use for septic tank absorption fields. The absorption field can be enlarged.

This soil is in capability subclass IIe. This soil was not placed in a woodland suitability group.

MeA—Martinsville loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on terraces and outwash plains. Areas are round or irregular in shape and range from 5 to 90 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark grayish brown loam about 8 inches thick. The subsurface layer is dark brown loam about 3 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam; the middle part is yellowish brown, firm clay loam; and the lower part is dark yellowish brown sandy loam with a thin stratum of sandy clay loam. The substratum is dark yellowish brown and dark brown, stratified sandy loam, sandy clay loam, silt loam, and loamy sand to a depth of 80 inches. In some small areas the subsoil and substratum have no stratification. In some areas a layer of sandy loam more than 20 inches thick is in the upper part of the profile.

Included with this soil in mapping are small areas of Bronson and Whitaker soils in swales; they make up about 8 percent of the unit. Also included are small areas having slopes of more than 2 percent; they make up less than 3 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Martinsville soil is moderate. Organic matter content is moderate in the surface layer. Available water capacity is high. Surface runoff is slow. The surface layer is friable and easily tilled through a fairly wide range of moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for pasture, hay, or woodland.

This soil is well suited to corn, soybeans, and small grains. Minimum tillage, crop residue management, and cover crops help to maintain and improve organic matter content and tilth.

This soil is well suited to grasses and legumes for hay and pasture. Grazing during excessively wet periods causes surface compaction and poor tilth. Overgrazing reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, and grazing at the right times help to keep pasture and soil in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, spraying, or girdling.

Shrinking and swelling moderately limits use of this soil for building sites. Properly designing footings and foundations helps to prevent damage. Low strength and frost action moderately limit use for local roads and streets; the base material can be strengthened or replaced. Limitations for septic tank absorption fields are slight.

This soil is in capability class I and woodland suitability subclass 1o.

MeB—Martinsville loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on terraces and outwash plains. Areas are elongated and irregular in shape and range from 5 to 70 acres in size. The usual size is about 10 acres.

In a typical profile the surface layer is dark grayish brown loam about 8 inches thick. The subsurface layer is dark brown loam about 3 inches thick. The subsoil is about 42 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam; the middle part is dark yellowish brown, firm clay loam and sandy clay loam; and the lower part is dark yellowish brown, friable sandy loam with a thin stratum of sandy clay loam. The substratum is yellowish brown, stratified sandy loam, silt loam, and loamy sand to a depth of 80 inches. In some small areas this soil has a loam and sandy loam till substratum with no stratification. In some small areas the substratum contains coarse sand and gravel.

Included with this soil in mapping are small areas of Bronson and Whitaker soils in swales; they make up about 5 percent of the unit. Also included are small areas that are nearly level or that have slopes of more than 6 percent; these areas make up about 5 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Martinsville soil is moderate. Organic matter content is moderate in the surface layer. Available water capacity is high. Surface runoff is medium. The surface layer is friable and easily tilled through a fairly wide range of moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for pasture, hay, or woodland.

This soil is suited to corn, soybeans, and small grains. Crop rotation, minimum tillage, terraces diversions, contour farming, grassed waterways, and grade stabilization structures reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain or improve tilth and organic matter content. Subsurface tile is needed for adequate drainage of seepage areas in some of the drainageways and swales.

This soil is well suited to grasses and legumes for hay and pasture. Grazing during wet periods causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, and grazing at the right times help to keep pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are used for woodland. Plant competition is moderate.

Seedlings survive and grow well if competing vegetation is controlled by cutting, spraying, or girdling.

Shrinking and swelling moderately limits use of this soil for building sites. Properly designing foundations and footings helps to prevent damage. Low strength and frost action moderately limit use for local roads and streets; the base material can be strengthened or replaced. Limitations for septic tank absorption fields are slight.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

MeC2—Martinsville loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on knobs and ridges on terraces and outwash plains. Areas are elongated in shape and range from 3 to 60 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is grayish brown and dark brown loam about 8 inches thick. The subsoil is about 35 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam; the middle part is yellowish brown, firm clay loam; and the lower part is dark yellowish brown sandy loam with a thin stratum of sandy clay loam. The substratum is dark yellowish brown and dark brown, stratified sandy loam, sandy clay loam, silt loam, and loamy sand to a depth of 60 inches. In some small areas this soil has a loam and sandy loam till substratum with no stratification. In some small areas the substratum contains coarse sand and gravel.

Included with this soil in mapping are small areas of Bronson and Whitaker soils in swales; they make up less than 5 percent of the unit. Also included are small areas having slopes of more than 12 percent; they make up less than 3 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Martinsville soil is moderate. Organic matter content is moderate in the surface layer. Available water capacity is high. Surface runoff is medium. The surface layer is friable and easily tilled through a wide range of moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops.

This soil is suited to corn, soybeans, and small grains. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures help to prevent excessive soil loss. Crop residue management and cover crops also reduce erosion and help to maintain or improve tilth and organic matter content. Subsurface tile is needed for adequate drainage of seepage areas along some of the drainageways and swales.

This soil is well suited to grasses and legumes for hay or pasture. Grazing during wet periods causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, and grazing at the right times help to keep pasture and soil in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, spraying, and girdling.

Slope and shrinking and swelling moderately limit use of this soil for building sites. Properly designing footings and foundations helps to prevent damage. The slope can be modified by earthmoving and grading. Low strength, slope, and frost action moderately limit use for local roads and streets. Strengthening or replacing the base material helps to overcome the low strength and frost action. The slope also moderately limits use for septic tank absorption fields; The lines can be installed in deep trenches on the contour and the field can be enlarged.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

MgB—Metea loamy fine sand, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on moraines. Areas are usually elongated and irregular in shape and range from 3 to 70 acres in size. The usual size is about 20 acres.

In a typical profile the surface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is about 39 inches thick. The upper part of the subsoil is yellowish brown, loose fine sand; the middle part is yellowish brown, friable sandy loam; and the lower part is yellowish brown, firm clay loam. To a depth of 60 inches the substratum is brown, friable loam that contains free carbonates. In a few areas the loamy sand and sand upper layers are less than 20 inches or more than 40 inches thick.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Chelsea, Owosso, and Riddles soils. The Aubbeenaubbee soils are in lower positions and make up about 2 percent of the unit. The Chelsea, Owosso, and Riddles soils make up about 8 percent of the unit. Also included are areas of soils that have slopes of less than 2 percent or more than 6 percent; these areas make up less than 3 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

This Metea soil is very rapidly permeable in the upper part and moderately permeable in the lower part and in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and can be tilled through a wide range in moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for woodland.

This soil is suited to corn, soybeans, and small grains. Wind erosion limits use for cultivated crops. Stripcropping, cover crops, proper use of crop residues, crop rotation, minimum tillage, windbreaks, or a combination of these practices helps to reduce wind erosion and improve and maintain tilth and organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Overgrazed areas are subject to wind erosion.

Rotating pastures, strip-grazing, stocking at proper rates, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is well suited to trees, but few areas are used for woodland. Seedling mortality is moderate. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Competing vegetation can be controlled by spraying, cutting, or girdling. Controlling competing vegetation leaves more moisture and sunlight for the seedlings.

This soil is only slightly limited for building sites. Frost action moderately limits use for local roads and streets. Ditches placed along the roadway remove excess water and reduce frost action. The moderate permeability of the substratum moderately limits use for septic tank absorption fields. The absorption field can be enlarged.

This soil is in capability subclass IIIs and woodland suitability subclass 2s.

MgC—Metea loamy fine sand, 6 to 12 percent slopes. This moderately sloping, deep, well drained soil is on moraines. Areas are mostly elongated and irregular in shape and range from 3 to 60 acres in size. The usual size is about 20 acres.

In a typical profile the surface layer is dark brown loamy fine sand about 8 inches thick. The subsoil is about 32 inches thick. The upper part of the subsoil is brownish yellow, loose, friable fine sand; the middle part is yellowish brown, friable sandy loam; and the lower part is yellowish brown, firm clay loam. To a depth of 60 inches the substratum is yellowish brown, friable loam that contains free carbonates. In a few areas the loamy sand and sand upper layers are less than 20 inches or more than 40 inches thick.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Chelsea, Owosso, and Riddles soils. The Aubbeenaubbee soils are in swales and make up about 2 percent of the unit. The Chelsea, Owosso, and Riddles soils make up about 8 percent. Also included are some areas of soils that have slopes of less than 6 percent or more than 12 percent; these areas make up less than 3 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

This Metea soil is very rapidly permeable in the upper part and moderately permeable in the lower part and in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and can be tilled through a wide range in moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for woodland or for hay and pasture.

This soil is suited to corn, soybeans, and small grains. Wind erosion limits use for cultivated crops. Stripcropping, cover crops, proper use of crop residues, crop rotation, minimum tillage, windbreaks, or a combination of these practices reduces wind erosion and helps to maintain and improve tilth and organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Overgrazed areas are subject to wind erosion. Rotating pastures, strip-grazing, stocking at proper rates, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is well suited to trees, but few areas are used for woodland. Seedling mortality is moderate. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Competing vegetation can be controlled by spraying, cutting, or girdling. Controlling competing vegetation leaves more moisture and sunlight for the seedlings.

Slope moderately limits use of this soil for building sites. Slope can be modified by grading and leveling. Slope and frost action moderately limit use for local roads and streets. The slope can be modified by grading, and the road can be placed on the contour. Ditches placed along the roadway remove excess water and reduce frost action. Slope and permeability moderately limit use for septic tank absorption fields. The absorption field can be enlarged.

This soil is in capability subclass IIIe and woodland suitability subclass 2s.

Mn—Milford silty clay loam. This nearly level, deep, very poorly drained soil is on broad flats, in swales, and along narrow drainageways on the glacial lakebeds. It is occasionally ponded for brief periods by runoff from surrounding soils. Areas are round or elongated in shape and range from 3 to 140 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is black silty clay loam about 13 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is dark gray, mottled, very firm silty clay loam; and the lower part is gray, mottled, very firm silty clay. The substratum is dark gray silty clay loam to a depth of 60 inches. In some small areas the surface layer is loam or is less than 10 inches thick. In some small areas, the lower part of the subsoil contains more than 5 percent coarse fragments. In some places the lower part of the subsoil is stratified.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Crosier, and Whitaker soils on swells. They make up less than 10 percent of the unit.

Permeability of this Milford soil is moderately slow. The water table is often at or near the surface during winter and early spring. Available water capacity is high. Organic matter content is high in the surface layer. Runoff is very slow to ponded. The surface layer becomes cloddy and hard to work if tilled when too wet.

Most areas of this soil are drained and used for corn and soybeans. A few areas are used for hay, pasture, or woodland.

If adequately drained, this soil is well suited to corn, soybeans, and small grains. This soil is subject to ponding. It is wet and therefore warms up slowly in

spring. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Removing the excess water allows the soil to warm up faster in spring. This soil is also subject to puddling and crusting. Working the soil at the correct moisture content reduces puddling. Crop residue management, green manure crops, cover crops, and minimum tillage help to maintain and improve tilth and organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Drainage is necessary for high yields. Deep-rooted legumes such as alfalfa do not grow as well as shallow-rooted legumes. Overgrazing and grazing during excessively wet periods cause surface compaction and poor tilth. Overgrazing also reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is not rated for woodland. Drained areas are used for crops. Trees are usually planted only for windbreaks.

This soil is severely limited and generally unsuitable for building sites and septic tank absorption fields because of the ponding. Permeability also limits use for septic tank absorption fields. Alternate sites should be found. Frost action, ponding, and low strength severely limit use for local roads and streets. Drainage ditches along the road lower the water table. Crowning the road to provide drainage helps to reduce the effects of wetness and frost action. The road base should be strengthened with more suitable material.

This soil is in capability subclass IIw. This soil was not placed in a woodland suitability subclass.

Ne—Newton loamy fine sand. This nearly level, deep, very poorly drained soil is on broad outwash plains and in sandy lacustrine areas. It is frequently ponded for brief periods by runoff from surrounding soils. Areas are irregular to elongated in shape and range from 3 to 100 acres in size. The usual size is 15 acres.

In a typical profile the surface layer is black loamy fine sand 10 inches thick. The subsurface layer is very dark gray and very dark grayish brown loamy sand about 12 inches thick. The underlying material is grayish brown and light grayish brown, mottled sand to a depth of 60 inches. In some small areas this soil is slightly acid to neutral throughout. In some areas the surface layer is less than 10 inches thick. In some small areas, there is less than 10 inches of sandy loam or finer material in the upper 40 inches.

Included with this soil in mapping are small areas of Brems soils. The Brems soils are on swells and make up less than 5 percent of the unit.

Permeability of this Newton soil is rapid. Available water capacity is low. The organic matter content is high in the surface layer. Surface runoff is slow or ponded. The seasonal high water table is at or near the surface during a significant part of the year. The surface layer is friable and has good tilth.

Some areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for pasture, other areas are used for woodland.

This soil is suited to corn, soybeans, and small grains. The low available water capacity, wetness, and strong acidity are the main limitations. Artificial drainage is necessary; most large areas have some type of drainage system. Excessive drainage can cause droughtiness and wind erosion. With an adequate drainage system, row crops can be grown most of the time. Small grains are difficult to grow if the drainage system is inadequate because the high water table is at or near the surface during the growing season. Minimum tillage, crop residue management, and cover crops help to maintain and improve tilth and organic matter content.

If adequately drained, this soil is suited to grasses and legumes for hay or pasture. Because of acidity and the high water table, deep-rooted legumes such as alfalfa do not grow well. Overgrazing reduces the density and hardiness of plants, and overgrazed areas are subject to wind erosion. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is poorly suited to trees. Equipment limitations are severe. Seedling mortality, windthrow hazard, and plant competition are also severe because the water table is at or near the surface for extended periods. Unwanted trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling.

Ponding severely limits use of this soil for building sites. Drainage is difficult in most areas because this soil is commonly in the lowest part of the landscape. Suitable outlets such as storm sewers may not be available and pumping may be necessary. Ponding also severely limits use for local roads and streets. Drainage ditches along the road lower the water table. Elevating the roadbed avoids the wetness. Ponding and the poor filtering qualities of this soil severely limit use for septic tank absorption fields. Effluent from the septic tank could seep into the ground water.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

OsA—Oshtemo loamy sand, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on moraines and outwash plains. Areas are broad and irregularly shaped and range from 3 to 150 acres in size. The usual size is about 20 acres.

In a typical profile the surface layer is dark grayish brown loamy sand about 9 inches thick. The subsurface layer is yellowish brown loamy sand about 5 inches thick. The subsoil is about 36 inches thick. The upper part of the subsoil is dark brown, friable sandy loam; and the lower part is strong brown and very dark grayish brown, very friable gravelly loamy sand. The substratum

is brown, stratified gravelly sand and coarse sand to a depth of 60 inches. In some places, the subsoil is loamy sand or has more than 10 inches of loam or finer textured material. In some areas the depth to the sand and gravel substratum is less than 40 inches.

Included with this soil in mapping are areas of Brady, Bronson, and Riddles soils. The Brady and Bronson soils are in swales and make up about 5 percent of the unit. The Riddles soils make up about 2 percent of the unit.

Permeability of this Oshtemo soil is moderately rapid in the surface layer and subsoil and very rapid in the till substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and easily tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. Many areas are used for corn, soybeans (fig. 1), or small grains. Some areas are used for hay or pasture. A few areas remain in woodland.

This soil is suited to corn, soybeans, and small grains. Windbreaks, crop rotation, and minimum tillage reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain and improve organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness. Stocking at proper rates, rotating pastures, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is well suited to trees. A few areas are used for woodland. Seedling mortality is moderate because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Drought-tolerant species should be favored.

This soil is only slightly limited for building sites; however, concrete may corrode or cutbanks may cave in. Basement walls can be coated with material that

Figure 1.—Soybeans are a common crop on Oshtemo loamy sand, 0 to 2 percent slopes.

retards corrosion. Limitations for local roads and streets and for septic tank absorption fields are also slight. Effluent from the septic tank might seep into the ground water.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

OsB—Oshtemo loamy sand, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on undulating outwash plains and low knolls on the moraines. Areas are oblong and irregularly shaped and range from 3 to 100 acres in size. The usual size is about I5 acres.

In a typical profile the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 36 inches thick. The upper part of the subsoil is brown, very friable loamy sand; the middle part is dark brown and yellowish brown, friable sandy loam; and the lower part is yellowish brown, very friable gravelly loamy sand. The substratum is brown, gravelly sand and coarse sand to a depth of 60 inches. In some places the subsoil is loamy sand or has more than 10 inches of loam or finer textured material. In some areas the depth to the sand and gravel substratum is less than 40 inches.

Included with this soil in mapping are areas of Brady, Bronson, and Riddles soils. The Brady and Bronson soils are in swales and make up about 5 percent of the unit. The Riddles soils make up less than 4 percent.

Permeability of this Oshtemo soil is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and easily tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for hay or pasture. A few areas remain in woodland.

This soil is suited to corn, soybeans, and small grains. Windbreaks, crop rotation, and minimum tillage reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain and improve organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness. Stocking at proper rates, rotating pastures, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is well suited to trees, but few areas are used for woodland. Seedling mortality is moderate because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Seedlings survive and grow well if competing vegetation is controlled. Drought-tolerant species should be favored.

This soil is only slightly limited for building sites; however, cutbanks may cave in and concrete may corrode. Slope moderately limits use for small commercial buildings. The slope can be modified by grading and leveling. Limitations for septic tank absorption fields are also slight, although effluent might seep into the ground water.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

OsC—Oshtemo loamy sand, 6 to I2 percent slopes. This moderately sloping, deep, well drained soil is on undulating outwash plains and on moraines. Areas are irregular and elongated in shape and range from 3 to 65 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is brown loamy sand about 8 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is brown, very friable loamy sand; the middle part is dark yellowish brown, friable sandy loam; and the lower part is dark yellowish brown, very friable gravelly loamy sand. The substratum is brown gravelly sand and coarse sand to a depth of 60 inches. In some places the subsoil is loamy sand or has more than 10 inches of loam or finer textured material. In some areas the depth to the sand and gravel substratum is less than 40 inches.

Included with this soil in mapping are areas of Hillsdale and Riddles soils. They make up less than 10 percent of the unit.

Permeability of this Oshtemo soil is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is very friable and easily tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for hay or pasture. A few areas remain in woodland (fig. 2).

This soil is suited to corn, soybeans, and small grains. Windbreaks, crop rotation, and minimum tillage reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain and improve organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness. Stocking at proper rates, rotating pastures, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is well suited to trees. Seedling mortality is moderate because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Drought-tolerant species should be favored.

Slope moderately limits use of this soil for building sites. The slope can be modified by grading. Corrosion of concrete is a common but minor problem. Slope also moderately limits use for local roads and streets. The

Figure 2.—Pasture and woodland on Oshtemo soils.

slope can be modified by grading and leveling, or the road can be built on the contour. Slope moderately limits use for septic tank absorption fields; the system can be modified to compensate. Effluent from the septic tank may seep into the ground water.

This soil is in capability subclass IIIe and woodland suitability subclass 3s.

OsD—Oshtemo loamy sand, 12 to 18 percent slopes. This strongly sloping, deep, well drained soil is on moraines and along the drainageways on the uplands. Areas are irregular and elongated in shape and range from 3 to 35 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark brown loamy sand about 3 inches thick. The subsurface layer is yellowish brown loamy sand about 4 inches thick. The subsoil is about 35 inches thick. The upper part of the subsoil is strong brown and brown, friable sandy loam; and the lower part is yellowish brown, very friable gravelly loamy sand. The substratum is dark brown gravelly sand and coarse sand to a depth of 60 inches. In some small areas the subsoil has more than 10 inches of loam or finer textured material. In some areas the depth to the sand and gravel substratum is less than 40 inches.

Included with this soil in mapping are Fox, Hillsdale, and Riddles soils. They make up less than 10 percent of the unit.

Permeability of this Oshtemo soil is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is very friable and easily tilled through a fairly wide range in moisture content.

This soil is not farmed. Most areas are used for trees. Some areas are used for pasture.

This soil is suited to grasses and legumes for hay or pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness. Stocking at proper rates, rotating pastures, and deferring grazing during dry periods help to keep pasture and soil in good condition.

This soil is well suited to trees, and most areas are used for woodland. Seedling mortality is moderate because of droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Drought-tolerant species should be favored.

Slope severely limits use of this soil for building sites. During construction, disturbed areas should be kept as small as possible, and the areas should be sodded or seeded, mulched, and netted to reduce erosion. Sites may need to be graded or leveled to reduce slope. Slope also severely limits use for local roads and streets. The slope can be modified by grading or leveling, or the road can be built on the contour. Slope severely limits use for septic tank absorption fields. The system can be modified to compensate for the slope, and lines should be laid on the contour. Effluent from the septic tank may seep into the ground water.

This soil is in capability subclass IVe and woodland suitability subclass 3s.

OwA—Owosso sandy loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on moraines of the uplands. Areas are usually elongated to irregular in shape and range from 3 to 60 acres in size. The usual size is 25 acres.

In a typical profile the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is dark brown and dark yellowish brown, friable sandy loam; and the lower part is dark yellowish brown and yellowish brown, firm loam and clay loam. The substratum is brown loam to a depth of 60 inches. In some areas less than 20 inches of sandy loam material is over the clay subsoil. In some small areas the soil contains less clay throughout.

Included with this soil in mapping are small areas of Aubbeenaubbee and Metea soils. The Aubbeenaubbee soils are in swales and make up less than 2 percent of the unit. The Metea soils are sloping and make up less than 5 percent. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Owosso soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is friable and can be tilled easily through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for woodland.

This soil is well suited to corn, soybeans, and small grains. Crop residue management, cover crops, minimum tillage, and green manure crops help to maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. Overgrazing or grazing when the soil is wet are concerns in management. Grazing during excessively wet periods causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods reduce surface compaction and help to maintain good tilth and plant density.

This soil is well suited to trees, but few areas are used for woodland. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by spraying, cutting, or girdling.

This soil is only slightly limited for building sites. Frost action moderately limits use for local roads and streets. The upper layer of soil can be replaced or covered with suitable base material. The permeability of the subsoil moderately limits use of septic tank absorption fields; the system can be enlarged.

This soil is in capability subclass IIs and woodland suitability subclass 1o.

Pa—Palms muck, drained. This nearly level, deep, very poorly drained soil is in low areas on till plains or moraines. This soil is frequently ponded for short periods in winter and spring. Areas are irregular or round in shape and range from 3 to about 150 acres in size. The usual size is about 30 acres.

In a typical profile the surface layer is black muck about 13 inches thick. Below this is very dark brown, firm muck over black, friable muck to a depth of 26 inches. The substratum is dark gray, mottled, firm sandy clay loam to a depth of 36 inches. Below this to a depth of 60 inches is olive gray, mottled sandy clay loam. In many small areas the muck is more than 51 inches thick, or less than 51 inches of muck overlies marl or sand. In some areas the muck is less than 16 inches thick. In some areas, this soil contains as much as 10 inches of peat. In some areas the muck immediately above the substratum contains 30 percent mineral material.

Included with this soil in mapping are small areas of Brookston, Milford, and Rensselaer soils on swells. They make up less than 5 percent of the unit.

Permeability of this Palms soil is moderately slow to moderately rapid in the organic layer and moderate in the loamy substratum. Available water capacity is very high. The organic matter content is very high in the surface layer. Runoff is very slow. The seasonal high water table is frequently at the surface during the wettest parts of the year.

Most areas of this soil are used for crops. Corn, soybeans, mint, and truck crops are the major crops.

If adequately drained, this soil is suitable for corn, soybeans, mint, and truck crops. This soil is wet and warms up slowly in spring. However, insufficient moisture in summer causes the soil to be droughty. Also, this soil is subject to wind erosion and ponding. The ponding hinders use of equipment, and machinery bogs down. This soil is very unstable. Use of heavy equipment is hazardous, especially near drainage ditches. Excess water can be removed by open ditches, subsurface drains, pumping, or a combination of these practices. Removing excess water allows the soil to warm up faster in spring. However, after being drained the muck subsides and becomes susceptible to fire. Wind erosion can be controlled by windbreaks, crop residue management, minimum tillage, stripcropping, cover crops, or a combination of these practices. It can also be controlled by permanent vegetation. Crop residue

management, green manure crops, cover crops, and minimum tillage help to maintain and improve tilth and organic matter content.

This soil is suited to grasses for hay and pasture. The main concerns are overgrazing and grazing during wet periods. Overgrazing reduces plant density and hardiness. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is poorly suited to trees. Equipment limitations, seedling mortality, plant competition, and windthrow hazard are severe because of wetness and ponding. Undesirable vegetation can be controlled or removed by site preparation, spraying, cutting, or girdling. Water-tolerant species should be favored. Trees can usually be harvested only during extremely dry seasons or when the ground is frozen.

This soil is severely limited and generally unsuitable for building sites because of the ponding and low strength. Ponding and low strength also severely limit use for local roads and streets. The organic material can be replaced with more stable base material. Elevating the roadbed avoids the wetness. This soil is generally unsuitable for septic tank absorption fields because of the ponding. Another site should be found.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

PdA—Pinhook sandy loam, 0 to 2 percent slopes. This nearly level, deep, poorly drained soil is on broad flats on outwash plains. Areas are irregular in shape and range from 3 to 40 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsurface layer is grayish brown, mottled sandy loam about 5 inches thick. The subsoil is about 31 inches thick. The upper part of the subsoil is light brownish gray, mottled, friable sandy loam; the next part is gray, mottled, firm sandy loam; the next part is grayish brown, mottled, friable loamy sand; and the lower part is gray, mottled, very friable sand. The substratum is grayish brown sand and gravelly sand to a depth of 62 inches. In some places the surface layer is gray. In some small areas the subsoil is mainly brown with gray mottles. In some places the soil contains more sand.

Included with this soil in mapping are few small areas of Bronson and Gilford soils; they make up about 10 percent of the unit. The Bronson soils are on swells, and the Gilford soils are in swales.

Permeability of this Pinhook soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The organic matter content is high in the surface layer. Surface runoff is very slow. The seasonal high water table is at a depth of less than 1 foot during winter and early spring. The surface layer is friable and has good tilth.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for hay or pasture. A few areas are used for woodlands.

This soil is well suited to corn, soybeans, and small grains. Wetness is the main limitation. Excess water can be removed by open ditches, subsurface drains, pumping, or a combination of these practices. With adequate drainage and proper management, row crops can be grown intensively. Minimum tillage and crop residue management help to maintain and improve tilth and organic matter content.

If adequately drained, this soil is well suited to grasses and legumes for hay or pasture. Drainage is necessary for high yields. Because of wetness, deep-rooted legumes such as alfalfa do not grow well. Overgrazing and grazing during wet periods are concerns. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is suited to trees. Equipment limitations and plant competition are severe. Windthrow hazard and seedling mortality are moderate. Trees can usually be harvested only during dry seasons or in winter when the ground is frozen. Seedlings survive and grow well if competing vegetation is controlled by site preparation, spraying, cutting, or girdling. Water-tolerant species should be favored.

Wetness severely limits use of this soil for building sites. Artificial drainage is necessary, but suitable outlets may not be near. Dwellings should be built without basements. Wetness, low strength, and frost action severely limit use for local roads and streets. Drainage ditches along the road lower the water table and reduce frost action. Using more suitable base material overcomes the low strength of this soil. Wetness and poor filtering qualities of this soil severely limit use for septic tank absorption fields. Another site should be found.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

PsA—Plainfield sand, 0 to 2 percent slopes. This nearly level, deep, excessively drained soil is on broad flats on outwash plains. Areas are irregular in shape and range from 3 to more than 500 acres in size. The usual size is about 40 acres.

In a typical profile, the surface layer is dark brown sand about 7 inches thick. The subsoil is strong brown and yellowish brown, loose sand about 14 inches thick. The substratum is brownish yellow and light yellowish brown sand to a depth of 60 inches. In some small areas the subsoil has bands of loamy sand and sandy loam separated by layers of fine sand. In some areas the subsoil has slightly more silt and clay.

Included with this soil in mapping are a few small areas of Brems and Metea soils. The Brems soils are in the lower positions and make up less than 5 percent of

the unit. The Metea soils are sloping and make up less than 3 percent.

Permeability of this Plainfield soil is rapid. Available water capacity is low. The organic matter content is moderate in the surface layer. Surface runoff is slow.

Most areas of this soil are used for woodland. Some areas are farmed.

This soil is poorly suited to cultivated crops. Droughtiness is the main limitation. Wind erosion can be reduced by windbreaks, proper use of crop residue, minimum tillage, stripcropping, cover crops, or a combination of these practices. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay and pasture, which reduce wind erosion. Droughtiness is the main limitation. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces density and hardiness of plants, and overgrazed areas are subject to wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer help to reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe because of droughtiness. Plant competition is moderate. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Plow-planting and weeding may be necessary to control competing vegetation. Unwanted trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling. Pine usually do better than hardwoods in this soil.

This soil is only slightly limited for building sites; however, concrete may corrode and cutbanks may cave in. This soil is slightly limited for local roads and streets. The soil's poor filtering qualities severely limit use for septic tank absorption fields. Because the soil is rapidly permeable, effluent from the septic tank could contaminate the shallow ground water.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PsC—Plainfield sand, 3 to 10 percent slopes. This moderately sloping, deep, excessively drained soil is in broad areas and on ridges, knolls, and long side slopes. Areas are irregular to elongated in shape and range from 3 to about 100 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark brown sand about 5 inches thick. The subsoil is brownish yellow, loose sand about 18 inches thick. The substratum is brownish yellow and yellowish brown sand to a depth of 60 inches. In some small areas the subsoil has bands of loamy sand and sandy loam separated by layers of fine sand. In some areas the subsoil has slightly more silt and clay.

Included with this soil in mapping are a few small areas of Brems, Metea, and Oshtemo soils. The Brems soils are in the lower positions and make up about 3 percent of the unit. The Metea and Oshtemo soils make up less than 4 percent.

Permeability of this Plainfield soil is rapid. Available water capacity is low. The organic matter content is moderate in the surface layer. Surface runoff is slow.

Most areas of this soil are used for woodland. The remaining areas have been cleared for crops. Much of this cleared land has been planted to pine, used for hay and pasture, or used for wildlife habitat.

This soil is not suited to cultivated crops because of droughtiness and wind erosion.

This soil is suited to grasses and legumes for hay and pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Hay and pasture reduce wind erosion. Overgrazing reduces density and hardiness of plants, and overgrazed areas are subject to wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip grazing, and rotating grazing during summer help to reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe because of droughtiness. Plant competition is moderate. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Plow-planting and weeding may be necessary to control competing vegetation. Unwanted trees and shrubs can be controlled or removed by site preparation, spraying, cutting, or girdling. Pine usually do better than hardwoods on this soil.

Use of this soil for building sites is limited mainly by slope. Slope can be modified by grading or leveling. Slope moderately limits use for local roads and streets. The slope can be modified by grading and excavating, or the road can be built on the contour. The soil's poor filtering qualities severely limit use for septic tank absorption fields. Because this soil is rapidly permeable, effluent from the septic tank could contaminate the ground water.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PsD—Plaindfield sand, 12 to 18 percent slopes. This strongly sloping, deep, excessively drained soil is on ridges, knolls, and long side slopes. Areas are irregularly shaped and range from 3 to about 40 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is brown sand about 4 inches thick. The subsoil is strong brown and yellowish brown sand about 18 inches thick. The substratum is light yellowish brown and brownish yellow sand to a depth of 60 inches. In some small areas the subsoil has bands of loamy sand and sandy loam separated by layers of fine sand. In some areas the subsoil has slightly more silt and clay.

Included with this soil in mapping are a few small areas of Metea and Oshtemo soils; they make up less than 3 percent of the unit. Also included are areas that have slopes of less than 12 percent; they make up about 3 percent of the unit.

Permeability of this Plainfield soil is rapid. Available water capacity is low. The organic matter content is low in the surface layer. Surface runoff is slow.

Most areas of this soil are used for woodland. Some areas are used for hay and pasture.

This soil is not suited to cultivated crops because of slope, droughtiness, and wind erosion.

This soil is poorly suited to grasses and legumes for hay and pasture. Droughtiness and wind erosion are the main limitations. A permanent cover of drought-tolerant plants controls wind erosion.

This soil is suited to trees. Seedling mortality and equipment limitations are severe. Erosion hazard and plant competition are moderate. The problems are caused by droughtiness. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Timber can usually be harvested only while the ground is frozen. Proper road design and careful harvesting reduce erosion. Unwanted trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling.

Slope severely limits use of this soil for building sites. The buildings can be specially designed, or the slope can be modified by grading. Slope also severely limits use for local roads and streets. The roads can be placed on the contour. Slope and the soil's poor filtering qualities severely limit use for septic tank absorption fields. It is usually necessary to install the lines on the contour in deep trenches. The ground water can become contaminated.

This soil is in capability subclass VIIs and woodland suitability subclass 3s.

Re—Rensselaer loam. This nearly level, deep, very poorly drained soil is on broad flats, in swales, and along upland drainageways. It is occasionally ponded for short periods by runoff from surrounding areas. Areas are irregular in shape and range from 3 to about 300 acres in size. The usual size is about 40 acres.

In a typical profile the surface layer is very dark gray loam about 11 inches thick. The subsurface layer is very dark grayish brown loam about 4 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark gray and gray, mottled, firm clay loam; and the lower part is gray, mottled, friable loam. The substratum is gray, mottled, stratified fine sand and silt loam to a depth of 60 inches. In many small areas the subsoil has less clay. In places the combined surface and subsurface layers are less than 10 inches thick. In other areas the substratum is loam till. In some small areas the subsoil is not stratified and the substratum is coarse sand and gravelly sand. In some small areas the surface layer is mucky loam.

Included with this soil in mapping are small areas of Crosier, Milford, and Whitaker soils. The Crosier and Whitaker soils are in the slightly higher positions and make up 8 percent of the unit. The Milford soils make up about 3 percent.

Permeability of this Rensselaer soil is slow. Available water capacity is high. The organic matter content is high in the surface layer. Runoff is slow to ponded. The seasonal high water table is frequently at the surface. The surface layer is friable or very friable and is easy to work under proper moisture conditions. Tilling this soil when it is too wet causes the formation of large clods that become firm when they dry. These clods make preparing a seedbed difficult.

Most areas of this soil have been drained and are used for crops. Corn, soybeans, and small grains are the major crops. A few small areas are used for hay and pasture, and a few are used for woodland.

This soil is well suited to corn, soybeans, and small grains. Flooding is a hazard. Wetness is the main limitation. This soil warms up slowly in spring. Puddling and crusting are also problems. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Removing the excess water allows the soil to warm up faster in spring. Working the soil at the correct moisture content reduces crusting. Crop residue management, green manure crops, cover crops, and minimum tillage help to maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. Drainage is necessary for high yields. Overgrazing or trampling by livestock when the soil is wet reduces plant density and hardiness, reduces forage yields, damages the sod, and causes surface compaction and poor tilth. Stocking at proper rates, deferring grazing at appropriate times, restricting use during wet periods, strip-grazing, and rotating pastures help to reduce surface compaction, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suited to trees. Equipment limitations, seedling mortality, plant competition, and windthrow hazard are severe because of the seasonal high water table and flooding. Harvesting and logging during dry periods or in winter relieves the equipment limitations. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later. Water-tolerant species should be favored. Plow-planting and weeding may be necessary to control competing plants. Unwanted trees and shrubs can be controlled or removed by site preparation, spraying, cutting, or girdling.

Ponding severely limits use of this soil for building sites. An adequate drainage system and storm sewers lower the water table. Pumping may be necessary if drainage outlets are not available. Hauling in suitable fill and building houses on raised areas avoid the excess water. Houses should be built without basements.

Ponding, frost action, and low strength severely limit use for local roads and streets. Hauling in suitable fill and constructing roads on raised areas avoid the excess water. Road ditches lower the water table and reduce frost action. This soil is generally unsuitable for septic tank absorption fields because of the ponding and slow permeability. An alternate site should be found.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

RsA—Riddles sandy loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on moraines on the uplands. Areas are usually elongated to irregular in shape and range from 3 to 90 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is dark brown sandy loam about 5 inches thick. The subsoil is about 38 inches thick. The upper part of the subsoil is strong brown, firm clay loam; and the lower part is brown, friable loam. To a depth of 60 inches, the substratum is light yellowish brown loam that contains free carbonates. In a few small areas the surface layer is loamy sand. In a few small areas depth to the calcareous substratum is less than 42 inches. In a few areas the lower part of the subsoil is stratified sandy loam, loamy sand, and sandy clay loam over glacial till.

Included with this soil in mapping are some small areas of Crosier, Hillsdale, and Metea soils. The somewhat poorly drained Crosier soils are in the lower positions and make up about 3 percent of the unit. The Hillsdale soils are sloping and make up about 3 percent. The Metea soils are more sandy in the upper part and make up about 5 percent. Also included are areas having slopes of more than 2 percent; they make up less than 3 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Riddles soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is friable and can be tilled easily through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for woodland.

This soil is well suited to corn, soybeans, and small grains. Crop residue management, cover crops, minimum tillage, and green manure crops help to maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. Overgrazing of grazing during excessively wet periods causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction and maintain good tilth and plant density.

This soil is well suited to trees, but few areas are used for woodland. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are removed by spraying, cutting, or girdling.

Shrinking and swelling moderately limit use of the soil for building sites. Properly designing footings and foundations reduces damage. Low strength and frost action moderately limit use for local roads and streets; the base material can be strengthened or replaced. The moderate permeability of the subsoil moderately limits use for septic tank absorption fields. The field should be enlarged.

This soil is in capability class I and woodland suitability subclass 1o.

RsB—Riddles sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on moraines. Areas are usually elongated and irregular in shape and range from 3 to 100 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 39 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam; and the lower part is yellowish brown, firm clay loam. To a depth of 60 inches the substratum is brown loam that contains free carbonates. In a few areas the surface layer is loamy sand. In a few small areas depth to the calcareous substratum is less than 42 inches. In a few areas the lower part of the subsoil is stratified sandy loam, loamy sand, and sandy clay loam over glacial till. In a few small areas the subsoil has less clay.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Crosier, and Metea soils. The somewhat poorly drained Aubbeenaubbee and Crosier soils are in the lower positions and make up less than 5 percent of the unit. The sandy Metea soils make up about 5 percent. Also included are some areas of severely eroded Riddles soils on shoulder slopes; they make up about 2 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Riddles soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is friable and can be easily tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for woodland.

This soil is well suited to corn, soybeans, and small grains. Erosion limits use for cultivated crops. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and graded stabilization structures reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. Overgrazing or grazing during wet periods causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at

appropriate times, and restricting use during wet periods help to reduce surface compaction and maintain good tilth and plant density.

This soil is well suited to trees, but few areas are used for woodland. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by spraying, cutting, or girdling.

Shrinking and swelling moderately limit use of this soil for building sites. Properly designing foundations, footings, and basement walls and installing foundation drain tile help to prevent damage. Low strength and frost action moderately limit use for local roads and streets. The base material can be strengthened or replaced. The permeability of the subsoil moderately limits use for septic tank absorption fields. The absorption field can be enlarged.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

RsC2—Riddles sandy loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on moraines. Areas are usually elongated and irregular in shape and range from 3 to 40 acres in size. The usual size is about 10 acres.

In a typical profile the surface layer is dark brown and yellowish brown sandy loam about 7 inches thick. A small amount of subsoil material has been mixed into the eroded surface layer. The remaining subsoil is about 35 inches thick. The upper part of the subsoil is yellowish brown, firm clay loam; and the lower part is yellowish brown, friable loam. To a depth of 60 inches the substratum is light yellowish brown loam that contains free carbonates. In a few areas the surface layer is loamy sand. In some areas depth to the calcareous substratum is less than 42 inches. In a few areas the lower part of the subsoil is stratified sandy loam, loamy sand, and sandy clay loam over glacial till. In some areas the substratum is sandy loam glacial till. In a few small areas the subsoil contains less clay.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Crosier, and Metea soils. The somewhat poorly drained Aubbeenaubbee and Crosier soils are in lower positions and make up about 3 percent of the unit. The Metea soils make up about 3 percent. Also included are some small severely eroded areas; they make up less than 2 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Riddles soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. The surface layer is friable and can be tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for woodland or hay and pasture.

This soil is suited to corn, soybeans, and small grains. Erosion and suface runoff limit use for row crops. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain tilth and organic matter content.

This soil is suited to grasses and legumes for hay and pasture, which reduce erosion. Overgrazing or grazing during wet periods causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction and maintain good tilth and plant density.

This soil is well suited to trees. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by spraying, cutting, or girdling.

Slope and shrinking and swelling moderately limit use of this soil for building sites. Properly designing foundations, footings, and basement walls prevents damage caused by shrinking and swelling. The slope can be modified by earthmoving and grading. During construction, cleared areas should be kept as small as possible, and the areas should be sodded or mulched, netted, and seeded to reduce erosion. Low strength, slope, and frost action moderately limit use for local roads and streets. The base material can be strengthened or replaced and the slope can be modified by grading. Slope and the permeability of the subsoil moderately limit use for septic tank absorption fields. The system can be built on the contour, and the absorption field can be enlarged to compensate for the moderate permeability.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

RsD—Riddles sandy loam, 12 to 18 percent slopes. This strongly sloping, deep, well drained soil is on moraines. Areas are usually elongated in shape and range from 3 to 30 acres in size. The usual size is about 10 acres.

In a typical profile the surface layer is dark grayish brown sandy loam about 6 inches thick. The subsurface layer is dark brown sandy loam about 3 inches thick. The subsoil is about 36 inches thick. The upper part of the subsoil is yellowish brown, firm clay loam; and the lower part is yellowish brown, friable loam. To a depth of 60 inches the substratum is light yellowish brown loam that contains free carbonates. In a few areas the surface layer is loamy sand. In a few areas the depth to the calcareous substratum is less than 42 inches. In a few areas the lower part of the subsoil is stratified sandy loam, loamy sand, and sandy clay loam over glacial till. In a few small areas the subsoil contains less clay.

Included with this soil in mapping are some small areas of Metea soils; they make up less than 3 percent of the unit. Also included are areas having slopes of less than 12 percent or more than 18 percent; they make up less than 3 percent of the unit. Making up less than 2

percent of the unit are a few small areas of severely eroded soils that are farmed. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Riddles soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is friable and can be tilled through a fairly wide range in moisture content.

Most areas of this soil remain in woodland. A few small areas are farmed and used for hay and pasture (fig. 3).

This soil is poorly suited to corn, soybeans, and small grains. Erosion and surface runoff limit use for row crops. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures reduce erosion. The choice of conservation practices depends on the size of the area of this soil and on the practices being used on the surrounding soils. Crop residue management and cover crops also reduce erosion and help to maintain and improve tilth and organic matter content.

This soil is suited to grasses and legumes for hay and pasture, which reduce erosion. Overgrazing or grazing during wet periods causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction and maintain good tilth and plant density.

This soil is well suited to trees. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by spraying, cutting, and girdling.

Figure 3.—Pasture on moderately sloping and strongly sloping Riddles soils.

Slope severely limits use of this soil for building sites, and shrinking and swelling is a moderate limitation. During construction, cleared areas should be kept as small as possible, and the areas should be sodded or seeded, mulched, and netted to reduce erosion. Properly designing foundations, footings, and basement walls prevents damage caused by shrinking and swelling. Slope also severely limits use for local roads and streets; the roads can be placed on the contour. Slope severely limits use for septic tank absorption fields; the lines can be installed on the contour.

This soil is in capability subclass IVe and woodland suitability subclass 1o.

SpA—Shipshe sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on terraces and outwash plains. It is moderately deep over sand and gravelly sand. Areas are usually large and irregular in shape and range from 5 acres to 200 acres in size. The usual size is about 50 acres.

In a typical profile the surface layer is very dark grayish brown sandy loam about 11 inches thick. The subsurface layer is dark brown sandy loam about 4 inches thick. The subsoil is dark brown, friable gravelly sandy loam about 11 inches thick. The substratum is dark brown, massive sand in the upper part and brown and light yellowish brown, loose, stratified gravelly sand and coarse sand to a depth of 60 inches. In a few small areas depth to the substratum is less than 24 inches. In other areas the surface layer is thinner and lighter colored.

Included with this soil in mapping are some small areas of Fox, Oshtemo, and Troxel soils. The Fox and Oshtemo soils make up less than 5 percent of the unit. The Troxel soils are in the lower positions and make up about 3 percent.

Permeability of this Shipshe soil is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low. The organic matter content is high in the surface layer. Surface runoff is slow. The surface layer is friable and can be tilled through a wide range in moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. A few areas are used for hay and pasture.

This soil is suited to corn, soybeans, and small grains. This soil is droughty during summer because of the shallow depth to the underlying sandy material. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay or pasture. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing or grazing during excessively wet periods causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times,

and restricting use during wet periods help to reduce surface compaction and maintain good tilth and plant density.

This soil is not rated for woodland because trees are not native to this prairie soil. Trees are generally planted only for windbreaks.

This soil is only slightly limited for building sites. Frost action moderately limits use for local roads and streets; the upper layer of this soil can be replaced or covered with more suitable material. The poor filtering qualities of the soil severely limit use for septic tank absorption fields. Water in shallow wells could become contaminated.

This soil is in capability subclass IIIs. This soil was not placed in a woodland suitability subclass.

St—Stonelick sandy loam. This nearly level, deep, well drained soil is on flood plains. This soil is frequently flooded for very brief periods. Areas are linear in shape and range from 3 to 65 acres in size. The usual size is about 10 acres.

In a typical profile the surface layer is dark brown sandy loam about 9 inches thick. The substratum is dark brown and dark yellowish brown, friable sandy loam in the upper part; dark brown and grayish brown, mottled, friable loam and sandy loam in the next part; and grayish brown and yellowish brown, mottled, friable, stratified silt loam and sandy loam to a depth of 60 inches. In a few small areas the substratum has mottles at a depth of 20 inches.

Included with this soil in mapping are some small areas of Fluvaquents in the lower positions on the flood plains. They make up about 6 percent of the unit.

Permeability of this Stonelick soil is moderately rapid. Available water capacity is moderate. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is friable and can be tilled easily through a fairly wide range in moisture content.

Most areas of this soil are used for woodland. Small areas are farmed. Corn, soybeans, and small grains are the common crops. Some areas of this soil are used for pasture.

This soil is suited to corn and soybeans. Flooding is the main concern. Droughtiness caused by the moderately rapid permeability is also a hazard during dry periods. Difficulty of access and small size of areas of this soil limit its use. Minimum tillage, crop residue management, green manure crops, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is poorly suited to grasses and legumes for hay or pasture. Flooding can damage the grasses and legumes or temporarily restrict grazing. Droughtiness is also a hazard during dry periods. Overgrazing during summer reduces plant density and hardiness. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during dry periods help to maintain good plant density and hardiness and keep the pasture in good condition.

This soil is suited to trees. Plant competition is moderate. Competing vegetation can be controlled by site preparation or by spraying, cutting, or girdling. Difficulty of access and position interfere with woodland management.

Because of the flooding, this soil is severely limited and generally unsuitable for building sites, local roads and streets, and septic tank absorption fields. Alternate sites should be found.

This soil is in capability subclass IIs and woodland suitability subclass 2o.

Tx—Troxel silt loam. This nearly level or depressional, deep, well drained soil is in small potholes on outwash plains. This soil is occasionally ponded for very brief periods by runoff from surrounding soils. Areas are small and generally round in shape and range from 3 to 16 acres in size. The usual size is about 5 acres.

In a typical profile the surface layer is black silt loam in the upper 23 inches and very dark brown silt loam in the lower 4 inches. The subsoil is about 48 inches thick. The upper part of the subsoil is dark brown, friable loam; the middle part is dark brown, firm clay loam; and the lower part is dark brown, friable loam. The substratum is loose sand to a depth of 80 inches. In some small areas the dark surface layer is less than 24 inches thick. In some places, the sandy substratum is closer to the surface and the surface layer is loam.

Included with this soil in mapping are a few small areas of Washtenaw soils. They make up less than 3 percent of the unit.

Permeability of this Troxel soil is moderate. Available water capacity is high. The organic matter content is high in the surface layer. Surface runoff is ponded. The surface layer is friable and easily tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for hay or pasture. A few small areas are used for trees.

This soil is suited to corn, soybeans, and small grains. This soil can be intensively row cropped. Ponding is the main limitation. Crop residue management and cover crops help to maintain tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. Overgrazing or grazing during wet periods causes surface compaction and poor tilth. Overgrazing also reduces the density and hardiness of plants. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is not rated for woodland because most of the trees on this prairie soil were planted for windbreaks.

The brief ponding severely limits use of this soil for building sites. Adequate storm sewers are needed. The high potential frost action, low strength, and ponding severely limit use for local roads and streets. The base

material can be strengthened or replaced to prevent damage caused by frost action or low strength. This soil is poorly suited for septic tank absorption fields because of the ponding. Alternate sites should be found.

This soil is in capability class I. This soil was not placed in a woodland suitability subclass.

TyA—Tyner loamy sand, 0 to 2 percent slopes. This nearly level, deep, well drained soil is in outwash areas on the uplands. Areas are broad and irregular in shape and range from 5 to 250 acres in size. The usual size is about 45 acres.

In a typical profile the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is about 35 inches thick. The upper part of the subsoil is dark yellowish brown and yellowish brown, very friable loamy sand; and the lower part is yellowish brown fine sand. The substratum is light yellowish brown, loose medium sand to a depth of 60 inches. In a few small areas the lower part of the subsoil has sandy loam bands. In other small areas this soil is sand to a depth of 60 inches. In some areas the subsoil contains more clay.

Included with this soil in mapping are some small areas of Brems soils in lower positions; they make up about 5 percent of the unit. Also included are areas having slopes of more than 2 percent; they make up less than 3 percent of this unit.

Permeability of this Tyner soil is rapid. Available water capacity is low. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and can be tilled easily through a fairly wide range in moisture content.

Most areas of this soil are farmed. The major crops are corn, soybeans, and small grains. Some areas are used for hay, pasture, or pine plantations.

This soil is poorly suited to corn, soybeans, and small grains. The main limitation is droughtiness. Wind erosion is also a problem. Wind erosion can be controlled by windbreaks, proper use of crop residues, minimum tillage, stripcropping, or a combination of these practices. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay or pasture. Hay and pasture reduce wind erosion. Droughtiness is the main limitation. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness, and overgrazed areas are subject to wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer help to reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suited to trees, but few areas are used for woodland. Seedling mortality is moderate. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later.

This soil is only slightly limited for building sites; however concrete may corrode and cutbanks may cave in. Limitations for local roads and streets are also slight. The poor filtering qualities of the soil severely limit use for septic tank filter fields. Effluent from the septic tank could contaminate the ground water.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

TyB—Tyner loamy sand, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on knobs in outwash areas on the uplands. Areas are irregular and elongated in shape and range from 5 to 120 acres in size. The usual size is about 25 acres.

In a typical profile the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is about 34 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, very friable loamy sand; and the lower part is yellowish brown, loose sand. The substratum is light yellowish brown sand to a depth of 60 inches. In a few small areas of this soil the lower part of the subsoil has sandy loam bands. In other small areas this soil is sand to a depth of 60 inches. In some areas the subsoil contains more clay.

Included with this soil in mapping are small areas of Brady and Brems soils in lower positions; they make up about 5 percent of the unit. Also included are areas having slopes of more than 6 percent; they make up about 2 percent of the unit.

Permeability of this Tyner soil is rapid. Available water capacity is low, and the soil is droughty. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and can be tilled easily through a fairly wide range in moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for pine plantations, hay, or pasture.

This soil is poorly suited to corn, soybeans, and small grains. The main limitation is droughtiness. Wind erosion is also a problem. Wind erosion can be controlled by windbreaks, proper use of crop residue, minimum tillage, stripcropping, or a combination of these practices. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay or pasture. Hay and pasture reduce wind erosion. Droughtiness is the main limitation. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness, causes surface compaction, and allows wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer help to reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suited to trees, but few areas are used for woodland. Seedling mortality is moderate. Planting more

trees than usual can compensate for the seedling mortality, but thinning may be required later.

This soil is only slightly limited for building sites; however, concrete may corrode and cutbanks may cave in. Basement walls can be coated with material that retards corrosion. Limitations for local roads and streets are severe. Because of the rapid permeability of the subsoil and the soil's poor filtering qualities, effluent from the septic tank could contaminate the ground water.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

TyC—Tyner loamy sand, 6 to 12 percent slopes. This moderately sloping, deep, well drained soil is on ridges and hills in outwash areas on the uplands. Areas are usually elongated in shape and range from 3 to 80 acres in size. The usual size is about 18 acres.

In a typical profile the surface layer is brown loamy sand about 7 inches thick. The subsoil is about 31 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, very friable loamy sand; and the lower part is yellowish brown, loose fine sand. The substratum is light yellowish brown, loose sand to a depth of 60 inches. In a few small areas the lower part of the subsoil has sandy loam bands. In other small areas the soil is sand to a depth of 60 inches. In some areas the subsoil contains more clay.

Included with this soil in mapping are some small areas of Brems soils in lower positions. They make up about 3 percent of the unit.

Permeability of this Tyner soil is rapid. Available water capacity is low, and the soil is droughty. The organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is very friable and can be easily tilled through a wide range in moisture content.

Some areas of this soil are farmed. The common crops are corn, soybeans, and small grains. Other areas are used for woodland, hay, or pasture.

This soil is poorly suited to corn, soybeans, and small grains. The main limitation is droughtiness. Wind erosion is also a problem. Wind erosion can be controlled by windbreaks, proper use of crop residues, minimum tillage, stripcropping, or a combination of these practices. Minimum tillage, crop residue management, green manure crops, additions of manure, and cover crops help to maintain and improve tilth, organic matter content, and moisture content.

This soil is suited to grasses and legumes for hay or pasture. Hay or pasture reduces wind erosion. Droughtiness is the main limitation. Deep-rooted legumes and drought-tolerant grasses are best suited to this soil. Overgrazing reduces plant density and hardiness, and overgrazed areas are subject to wind erosion. Stocking at proper rates, deferring grazing at appropriate times, strip-grazing, and rotating pastures during summer help to reduce wind erosion, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suited to trees, but few areas are used for woodland. Seedling mortality is moderate. Planting more trees than usual can compensate for the seedling mortality, but thinning may be required later.

Slope moderately limits use of this soil for building sites. Also, cutbanks may cave in and concrete may corrode. Slope can be modified by earthmoving, cutting, and grading. Basement walls can be coated with material that retards corrosion. Slope also moderately limits use for local roads and streets. The slope can be modified by grading and leveling, or the roadway can be placed on the contour. The soil's poor filtering qualities severely limit use for septic tank absorption fields. The distribution lines should be placed on the contour. Because of the rapid permeability of the subsoil and the soil's poor filtering qualities, effluent from the septic tank could contaminate the ground water.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

Ua—Udorthents, loamy. These nearly level soils are on outwash plains and moraines. Areas are irregular in shape and range from 3 to 100 acres in size. The usual size is about 8 acres.

Most areas of Udorthents have been mined for sand or gravel and then abandoned. The soils are dominantly sandy loam or gravelly sandy loam that has a large proportion of gravel and coarse sand.

Included with Udorthents in mapping are some small areas of finer textured soils. Also included are areas having slopes of more than 2 percent. Included areas make up about 10 percent of the unit.

These soils are seldom used for crops. Trees, woody shrubs, and rough grasses make up most of the plant cover. Some areas have no vegetation. These soils are used mainly for wildlife habitat, excavated ponds, and rough pasture.

Onsite investigation is needed before using these soils for building sites, local roads and streets, or septic tank absorption fields. The filtering qualities of the soils are poor. Effluent from sanitary facilities can seep into the ground water.

Udorthents were not placed in a capability subclass or a woodland suitability subclass.

Wa—Wallkill loam. This nearly level, deep, very poorly drained soil is in narrow depressions and around broad flats of organic soils next to the uplands. This soil is frequently ponded for brief to long periods by runoff from surrounding soils. Areas are usually fairly small and elongated in shape and range from 3 to 40 acres in size. The usual size is about 5 acres.

In a typical profile the surface layer is dark gray loam about 9 inches thick. The subsoil is very dark gray, firm silt loam about 7 inches thick. The substratum is very dark gray and black mucky silt loam to a depth of 20 inches and black, friable muck to a depth of 60 inches. In some places the mineral layers are thinner.

Included with this soil in mapping are a few depressions of Houghton soils. They make up about 3 percent of the unit.

Permeability of this Wallkill soil is moderate in the mineral material and moderately rapid in the organic material. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is very slow to ponded. This soil has a prolonged seasonal high water table at or near the surface; some areas are ponded in early spring. The surface layer is friable and can be easily tilled under proper moisture conditions

Some areas of this soil are farmed. The common crops are corn, soybeans, and specialty crops. Some areas are used for hay or pasture. A few areas are wooded.

With an adequate drainage system, this soil is suited to corn, soybeans, and some small grains. It is poorly suited to winter wheat because ponding usually destroys the stands. Wetness is the main limitation. Excessive water can be removed by subsurface drains, surface drains, grassed waterways, pumping, or a combination of these practices. With drainage and proper management, row crops can be grown intensively. Minimum tillage and crop residue management help to maintain and improve tilth and organic matter content.

This soil is suited to grasses and legumes for hay or pasture. Drainage is necessary for high yields. Deep-rooted legumes such as alfalfa do not grow as well as shallow-rooted legumes. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces plant density and hardiness. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is not suited to trees, and only a few areas are used for woodland. Equipment limitations, seedling mortality, and windthrow hazard are severe because the seasonal high water table is at or near the surface for long periods.

This soil is severely limited and generally unsuitable for building sites because of the ponding and low strength. Drainage is difficult in most areas because this soil is commonly in the lowest parts of the landscape. Frost action, ponding, and low strength severely limit use for local roads and streets. Elevating the roadbed avoids the wetness. Replacing the base material helps to prevent damage. Ponding also severely limits use for septic tank absorption fields. Another site should be found.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

Wh—Washtenaw silt loam. This nearly level or depressional, deep, very poorly drained soil is on moraines, till plains, and outwash plains. It is frequently ponded for brief periods by runoff from surrounding soils. Areas are small and are irregular and elongated in shape. They range from 3 to 30 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 10 inches thick. The next layer is grayish brown, dark grayish brown, and very dark gray, friable loam about 13 inches thick. The upper part of the underlying buried soil is very dark gray, firm silt loam; the next part is dark grayish brown and grayish brown, mottled, firm clay loam; and the lower part is gray, mottled, firm clay loam to a depth of 66 inches. In areas adjacent to prairie soils, the surface layer is black. In a few areas the overwash is less than 20 inches thick. In some areas the soil is underlain by stratified sand and gravel or calcareous loam till.

Included with this soil in mapping are small areas of Wallkill soils. They make up less than 3 percent of the map unit.

Permeability of this Washtenaw soil is slow. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is very slow to ponded. This soil has a seasonal high water table at or near the surface during winter and spring.

Most areas of this soil are farmed. Where the soil is adequately drained, corn and soybeans are the major crops. A few areas are used for hay or pasture. Areas that are more difficult to drain are wooded.

If this soil is adequately drained, it is well suited to crops. Wetness is the main limitation. Artificial drainage and waterways are needed. Minimum tillage and crop residue management help to maintain and improve tilth and organic matter content.

The soil is suited to grasses and legumes for hay and pasture. Adequately drained areas produce high yields of forage or pasture. Because of the wetness, deep-rooted legumes such as alfalfa do not grow well. Overgrazing or grazing during wet periods causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to keep pasture and soil in good condition.

This soil is suited to trees. The windthrow hazard is moderate. Equipment limitations, seedling mortality, and plant competition are severe. Seedlings survive and grow best if competing vegetation is controlled. Undesirable trees and shrubs can be controlled or removed by site preparation, spraying, cutting, and girdling. Trees can usually be harvested only during dry seasons or when the ground is frozen. Water-tolerant species should be favored.

Ponding severely limits use of this soil for building sites. Building sites must be artificially drained. Dwellings should be built without basements. Ponding and frost action severely limit use for local roads and streets. The road base can be strengthened with more suitable material, and ditches can be installed along the road to lower the water table. This soil is generally unsuitable for septic tank absorption fields because of ponding and the slow permeability of the subsoil. Another site should be found.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

WkB—Wawasee sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on low knolls on the uplands. Areas are irregular in shape and range from 3 to 90 acres in size. The usual size is about 15 acres.

In a typical profile the surface layer is brown sandy loam about 10 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is strong brown and yellowish brown, firm loam; and the lower part is dark brown and dark yellowish brown, firm loam. The substratum is brown, friable loam to a depth of 60 inches. In small areas the depth to the calcareous substratum is more than 42 inches. In a few small areas the subsoil contains less clay.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Crosier, and Metea soils. The Aubbeenaubbee and Crosier soils are in the lower positions and make up about 3 percent of the unit. The Metea soils make up about 5 percent. Small areas of severely eroded soils that have a sandy clay loam surface layer make up about 2 percent. Also included are areas having slopes of less than 2 percent or more than 6 percent; they make up about 2 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Wawasee soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is friable and easily tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. A few small areas are used for hay and pasture. Some areas remain in woodland.

This soil is suited to corn, soybeans, and small grains. Erosion limits use for row crops. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain and improve tilth and organic matter content. Subsurface tile is needed for adequate drainage of seepage areas in some of the drainageways and swales.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing and grazing during wet periods are major concerns. Grazing during wet periods reduces density and hardiness of plants, decreases yields, damages the sod, and causes surface compaction, which results in poor tilth. Stocking at proper rates, deferring grazing at appropriate times, restricting use during wet periods, strip-grazing, and rotating pastures during summer help to reduce surface compaction and maintain a dense cover of hardy plants.

This soil is well suited to trees, but few areas are used for woodland. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by site preparation, spraying, cutting, and girdling.

This soil is only slightly limited for building sites. Frost action and low strength moderately limit use for local roads and streets. The base material can be strengthened or replaced. Limitations for septic tank absorption fields are slight.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

WkC2—Wawasee sandy loam, 6 to 12 percent slopes, eroded. This deep, moderately sloping, well drained soil is on knolls and ridges on broad uplands. Areas are irregular to elongated in shape and range from 3 to 45 acres in size. The usual size is about 11 acres.

In a typical profile the surface layer is brown sandy loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part of the subsoil is strong brown and yellowish brown, firm loam; and the lower part is dark brown and dark yellowish brown, firm loam. The substratum is brown, friable loam to a depth of 60 inches. In a few small areas the lower part of the subsoil is stratified. In a few small areas the depth to the calcareous substratum is more than 42 inches. In a few small areas the subsoil contains less clay.

Included with this soil in mapping are some small areas of Aubbeenaubbee, Crosier, and Metea soils and small areas of severely eroded soils that have a sandy clay loam surface layer. The Aubbeenaubbee and Crosier soils are in the lower positions and make up about 3 percent of the unit. The Metea soils make up about 5 percent. Also included are areas having slopes of less than 6 percent or more than 12 percent; they make up about 2 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Wawasee soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is friable and can be tilled through a fairly wide range in moisture content.

Most areas of this soil are farmed. Corn, soybeans, and small grains are the major crops. Some areas are used for woodland or hay and pasture.

This soil is suited to corn, soybeans, and small grains. Erosion limits use for row crops. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures reduce erosion. Crop residue management and cover crops also reduce erosion and help to maintain tilth and organic matter content.

This soil is suited to grasses and legumes for hay and pasture, which reduce erosion. Overgrazing or grazing during wet periods are major concerns. Grazing during wet periods causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods reduce surface compaction and help to maintain good tilth and plant density.

This soil is well suited to trees. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by spraying, cutting, or girdling.

Slope moderately limits use of this soil for building sites. The slope can be modified by grading and leveling. During construction, cleared areas should be kept as small as possible, and the areas should be sodded or seeded, mulched, and netted to reduce erosion. Frost action, slope and low strength moderately limit use for local roads and streets. The road base can be strengthened with more suitable material. Ditches along the roadway remove excess water and reduce frost action. Slope moderately limits use for septic tank absorption fields. Installing lines in deep trenches on the contour overcomes the limitations.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

WmD3—Wawasee sandy clay loam, 12 to 18 percent slopes, severely eroded. This strongly sloping, deep, well drained soil is on moraines. Areas are usually elongated in shape and range from 3 to 30 acres in size. The usual size is about 5 acres.

In a typical profile the surface layer is strong brown sandy clay loam about 6 inches thick. The subsoil is about 21 inches thick. The upper part of the subsoil is yellowish brown, firm loam; and the lower part is dark brown and dark yellowish brown, firm loam. The substratum is brown loam to a depth of 60 inches. In a few small areas the depth to the calcareous substratum is more than 42 inches. In a few small areas the subsoil contains less clay.

Included with this soil in mapping are some small areas of Metea soils; they make up about 5 percent of the unit. Also included are areas having slopes of less than 12 percent or more than 18 percent; they make up less than 5 percent of the unit. Some areas have stones and boulders that interfere with cultivation.

Permeability of this Wawasee soil is moderate. Available water capacity is high. The organic matter content is low in the surface layer. Surface runoff is rapid.

Most areas of this soil are not farmed. Most areas are used for hay or pasture.

This soil is not suited to cultivated crops because of the hazard of erosion and the steep slopes.

This soil is suited to grasses and legumes for hay and pasture, which reduce erosion. Overgrazing and grazing during wet periods are major concerns. Grazing during wet periods causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help to reduce surface compaction.

This soil is well suited to trees. Plant competition is moderate. Seedlings grow well if unwanted trees and shrubs are controlled by spraying, cutting, or girdling.

Slope severely limits use of this soil for building sites. During construction, cleared areas should be kept as small as possible, and the areas should be sodded or seeded, mulched, and netted to reduce erosion. Grading, leveling, and building diversions modify the slope and reduce the hazard of erosion. Slope severely limits use for local roads and streets; the road can be placed on the contour. Slope also severely limits use for septic tank absorption fields. Lines can be laid on the contour in deep trenches.

This soil is in capability subclass VIe and woodland suitability subclass 1o.

Wt—Whitaker loam. This nearly level, deep, somewhat poorly drained soil is on broad flats. Areas are irregular in shape and range from 3 to about 120 acres in size. The usual size is about 30 acres.

In a typical profile the surface layer is dark grayish brown loam about 9 inches thick. The subsurface layer is brown, mottled loam about 8 inches thick. The subsoil is about 31 inches thick. The upper part of the subsoil is grayish brown, mottled, firm clay loam; the middle part is grayish brown, mottled, firm sandy clay loam; and the lower part is dark yellowish brown, mottled, friable sandy loam. The substratum is brown, mottled, stratified loamy sand, silt loam, and loam to a depth of 60 inches. In a few small areas, the depth to the substratum is less than 42 inches. In some small areas, this soil has more sand in the upper part or is mostly gray in the subsoil.

Included with this soil in mapping are small areas of Martinsville and Rensselaer soils. The Martinsville soils are in higher positions, and the Rensselaer soils are in swales. They make up 8 percent of the unit. Also included are areas having slopes of more than 2 percent; they make up less than 3 percent of the unit.

Permeability of this Whitaker soil is moderate. Available water capacity is high. The organic matter content is moderate in the surface layer. Surface runoff is slow. The seasonal high water table fluctuates between depths of 1 and 3 feet. The surface layer is friable and is easy to work under proper moisture conditions. Tilling this soil when it is too wet causes formation of large clods that become firm when dry. These clods make preparation of a seedbed difficult.

Most areas of this soil are farmed. Most adequately drained areas are used for corn, soybeans, and small grains. A few small areas are used for hay and pasture or for woodland.

This soil is suited to corn, soybeans, and small grains. Wetness is the main limitation. Subsurface drainage systems, which have been established in most areas, increase production. Crop residue management, green manure crops, cover crops, minimum tillage, or a combination of these practices helps to maintain and improve tilth and organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. Drainage is necessary for high yields. Deep-rooted legumes such as alfalfa do not grow as well as shallow-rooted crops. Overgrazing or trampling by livestock when the soil is wet reduces plant density and hardiness, reduces forage yields, damages the sod, and causes surface compaction and poor tilth. Stocking at

proper rates, deferring grazing at appropriate times,and restricting use during wet periods help to reduce surface compaction, maintain a dense cover of hardy plants, and keep pasture and soil in good condition.

This soil is suitable for trees, but only a small acreage is used for woodland. Plant competition is moderate. Plow-planting and weeding may be necessary to control competing vegetation. Unwanted trees and shrubs can be controlled by site preparation, spraying, cutting, or girdling.

This soil is severely limited for dwellings, mainly by wetness. Building sites should be artificially drained, and pumping may be necessary where drainage outlets are not available. Houses should be built without basements. Frost action and low strength severely limit use for local roads and streets. Drainage ditches along the roads remove excess water and reduce frost action. The road base can be strengthened with more suitable material. Wetness also severely limits use for septic tank absorption fields. Drainage is needed.

This soil is capability subclass IIw and woodland suitability subclass 3o.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

Jerry J. Pearson, district conservationist, and R. Dean Manchester, soil conservation technician, Soil Conservation Service, helped to prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 235,849 acres in the survey area was cropland in 1975 (*3*). Of this, 202,817 acres was harvested cropland, mostly corn, soybeans, and wheat; 18,058 acres was rotation hay and pasture; and the remaining 14,974 acres was idle or was used for conservation purposes and permanent pasture. An additional 26,678 acres was in woodland.

The potential for converting land in Marshall County to increase food production is low. About 5,744 acres of potentially good cropland is currently in pasture. Food production could also be increased by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

The acreage in crops and pasture has gradually been decreasing as more and more land is used for urban development. In 1976 there was about 18,000 acres of urban and built-up land in the county; this figure has been growing at the rate of about 200 acres per year. The use of this soil survey to help make land use decisions that will influence the future of farming in the county is discussed in the section "Broad land use considerations."

Wetness is the major soil problem on about 46 percent of the cropland in Marshall County. Most areas of the very poorly drained soils (such as Adrian, Brookston, Houghton, and Rensselaer soils) are satisfactorily drained for farming. However, a few areas of these soils cannot be drained economically. They are in depressions, and drainage outlets would have to be deepened and extended great distances.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. In this category are the Aubbeenaubbee, Brady, Crosier, and Whitaker soils and Fluvaquents. These soils make up about 21 percent of the survey area.

Wawasee and Riddles soils have generally good natural drainage, but they tend to dry out slowly after rains. Small areas of wetter soils along drainageways

and swales are commonly included in areas of these soils, especially those that have slopes of 2 to 6 percent. Artificial drainage is needed in some of these wetter areas.

The design of artificial drainage systems varies with the kind of soil. A combination of surface drainage, open ditches, subsurface drainage, and pumping is needed in most areas of the very poorly drained soils used intensively for row crops. Drains have to be more closely spaced in slowly permeable soils, such as Brookston and Milford soils, than in soils that are more permeable. Finding adequate outlets is difficult in many areas of Adrian, Houghton, and Brookston soils.

Organic soils oxidize and subside when the pore space is filled with air. Therefore, special drainage systems are needed to keep the water table at the level required by crops during the growing season and raise the water table to the surface during the rest of the year. Such systems minimize oxidation and subsidence of organic soils. Some of the organic soils have special drainage problems. Edwards soils are muck over marl, so subsurface drainage is usually not feasible. Adrian soils are muck over sand; they can be overdrained, leading to rapid oxidation of the organic material.

Information on drainage for each kind of soil is available from local offices of the Soil Conservation Service.

Soil erosion by wind and water is the major soil problem on about 40 percent of the cropland in Marshall County. If slope is more than 2 percent, water erosion is a hazard. Many of the sandy or organic soils are susceptible to wind erosion during certain times of the year.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on loamy soils, such as Fox, Wawasee, and Riddles soils. Erosion also reduces productivity on soils that tend to be droughty, such as Tyner soils. Second, soil erosion results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves water quality for municipal use, for recreation, and for fish and wildlife.

Erosion control practices provide surface cover, reduce runoff, and increase infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops reduce erosion on sloping land and also provide nitrogen and improve tilth for the succeeding crop.

Practicing minimum tillage, maintaining plant cover, and leaving crop residue on the land reduce runoff and erosion. These practices can be adapted to most soils in the county. No-till farming for corn is effective in reducing wind and water erosion. It also can be used on most soils in the county. Many slopes are so short and irregular that contour tillage and terracing are not practical on many soils in Marshall County.

Diversions and parallel terraces with tile outlets shorten the effective length of slope and reduce sheet, rill, and gully erosion. They are most practical on deep, well drained soils that are highly susceptible to erosion. Terracing has many benefits. Less soil and associated fertilizer elements are lost. Damage to crops and watercourses is reduced. Fewer grassed waterways, which take productive land out of row crops, are needed, and less pesticide enters streams. Farming on the contour is easier, reducing the use of fuel. Many areas of Fox, Wawasee, Oshtemo, and Riddles soils are suitable for terraces. Soils that have a heavy clayey subsoil are less suitable for terraces and diversions.

Open ditches in sandy and organic soils are often not stable. The banks are subject to sloughing, and the ditches tend to fill up within a few years, reducing their capacity to remove excess water. Subsurface drains entering the ditches also become clogged. Ditchbank erosion can be controlled by establishing and maintaining sod on the ditchbanks. Seedling recommendations are available from local offices of the Soil Conservation Service.

Wind erosion is a hazard on organic soils, such as Adrian and Houghton soils. Strong winds can damage these soils in a few hours if the soils are dry and lack vegetation or surface mulch. Maintaining plant cover, surface mulch, or a rough surface through proper tillage minimizes erosion on these soils. Windbreaks of adapted shrubs are also effective. Wind also erodes mineral soils when they are barren. Soils that are plowed in fall are very susceptible to wind erosion in spring.

Most upland and outwash soils are naturally very strongly acid, strongly acid, or medium acid. They usually require applications of ground limestone to raise the pH enough for good growth of alfalfa. These soils have naturally low or moderate fertility. Available phosphorus and potash levels are low.

The soils on flood plains, such as Fluvaquents and Stonelick soils, are neutral or mildly alkaline and are higher in plant nutrients. The very poorly drained soils such as Adrian, Brookston, Edwards, Gilford, Houghton, Milford, Palms, Rensselaer, Wallkill, and Washtenaw soils are in slight depressions and receive runoff from adjacent upland soils. They normally are slightly acid or neutral.

On all soils, additions of lime and fertilizer should be based on the needs of the crop, on the expected yields, and on the results of soil tests. The Cooperative Extension Service can help in determining the kinds and amount of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous and have sufficient organic matter.

Some of the soils used for crops in this county have a loam or sandy loam surface layer that is dark in color and moderate in content of organic matter. Generally the structure of these soils is moderate to weak, and intense rainfall causes the formation of a crust on the surface. When dry, this crust is hard and impervious to water. Once a hard crust forms, infiltration of water is reduced and runoff is increased. Regularly adding crop residue, manure, and other organic material improves soil structure and reduces crust formation.

The dark colored Brookston, Milford, and Rensselaer soils contain a high percentage of clay. Tilth is a problem in these soils because they often stay wet until late spring. If plowed when wet, these soils tend to be very cloddy when dry, and a good seedbed is difficult to prepare. Plowing in fall generally results in good tilth in spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Corn and soybeans are the major row crops. Wheat and oats are the common close-growing crops. Rye could be grown, and seed could be produced from brome, fescue, redtop, and bluegrass.

Specialty crops are of limited commercial importance in the survey area. Only a small acreage is used for vegetables and small fruits (fig. 4). Soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables and fruits. In the survey area these are the Chelsea, Fox, Hillsdale, Elston, Linkville, Martinsville, Metea, Wawasee, Oshtemo, Owosso, Riddles, Tyner, and Shipshe soils that have slopes of less than 12 percent. These soils cover about 40 percent of the county. Crops can generally be planted and harvested earlier on these soils than on other soils in the county.

If adequately drained, the muck soils in the county are well suited to a wide range of vegetables. Adrian, Edwards, Houghton, Palms, and Wallkill soils make up about 7 percent of the county.

Figure 4.—Apple orchard on Wawasee and Riddles soils.

Most of the well drained soils in the county are suitable for orchards and nursery plants. Soils in low positions that are subject to frost late in spring and early in fall and that have poor drainage generally are poorly suited to early vegetables, fruits, and orchards.

Latest information and suggestions for growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible soil loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed soil map unit."

woodland management and productivity

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for

each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on the soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe,* that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, sorghum, and sunflowers.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these

plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, panicum, and foxtail.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattails, duckweed, waterlily, arrowhead, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, meadowlark, field sparrow, cottontail, red fox, killdeer, and woodchuck.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and whitetail deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, heron, shore birds, muskrat, mink, and beaver.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent,

surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper tranches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content

of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind

erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on

the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalf (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*5*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Adrian series

The Adrian series consists of deep, very poorly drained soils in bogs and old lakebeds on till plains and moraines. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sandy material. These soils formed in organic deposits over sandy material. Slope ranges from 0 to 2 percent.

Adrian soils are similar to Edwards, Houghton, and Palms soils. Edwards soils have 16 to 51 inches of muck over marl. Houghton soils have more than 51 inches of muck. Palms soils have 16 to 51 inches of muck over loamy material.

Typical pedon of Adrian muck, drained, in a cultivated field, 1,400 feet west and 200 feet north of the southeast corner of sec. 6, T. 34 N., R. 1 E.

Oap—0 to 8 inches; black (10YR 2/1) broken face and rubbed sapric material, black (10YR 2/1) dry; about 15 percent fiber, less than 3 percent rubbed; weak fine granular structure; friable; many very fine roots; primarily herbaceous fiber; neutral; abrupt smooth boundary.

Oa2—8 to 12 inches; black (N 2/0) broken face and rubbed sapric material; about 10 percent fiber, less than 3 percent rubbed; moderate medium subangular blocky structure; friable; few very fine roots; primarily herbaceous fiber; slightly acid; clear wavy boundary.

Oa3—12 to 30 inches; black (10YR 2/1) broken face and rubbed sapric material; about 25 percent fiber, less than 8 percent rubbed; weak medium subangular blocky structure; friable; few very fine roots; primarily herbaceous fiber; slightly acid; clear wavy boundary.

Oa4—30 to 35 inches; black (10YR 2/1) broken face and rubbed sapric material; about 15 percent fiber, less than 6 percent rubbed; massive; friable; primarily herbaceous fiber; less than 10 percent mineral material; neutral; abrupt wavy boundary.

IIC—35 to 60 inches; gray (10YR 5/1) sand; single grain; loose; 10 percent gravel; neutral.

The depth to the sandy IIC horizon is 16 to 51 inches. The organic material is mostly herbaceous. The organic material ranges from strongly acid to neutral.

The surface tier is black (10YR 2/1 or N 2/0) sapric material. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR, value 2 or 3, and chroma of 1 to 3; or they are neutral and have value of 3. The upper tier is strongly acid to neutral, and the lower tier is medium acid to neutral.

The IIC horizon is sand, loamy sand, gravelly sand, or gravelly loamy sand. It ranges from slightly acid to moderately alkaline. Content of coarse fragments ranges from 0 to 30 percent by volume.

Aubbeenaubbee series

The Aubbeenaubbee series consists of deep, somewhat poorly drained, moderately permeable soils on moraines on the uplands. These soils formed in loamy deposits. Slope ranges from 0 to 2 percent.

Aubbeenaubbee soils are similar to Crosier soils and are commonly near Brookston and Riddles soils. Crosier soils contain more clay in the upper part of the solum. Brookston soils have predominantly gray horizons in the subsoil and are in low areas. Riddles soils have a brown subsoil that is not mottled with gray and are in higher positions.

Typical pedon of Aubbeenaubbee sandy loam, 0 to 2 percent slopes, in a cultivated field, 1,880 feet south and 800 feet east of the northwest corner of sec. 21, T. 34 N., R. 1 E.

Ap—0 to 8 inches; grayish brown (10YR 5/2) sandy loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

A2—8 to 13 inches; brown (10YR 5/3) sandy loam; common medium distinct yellowish brown (10YR 4/4) and few fine faint grayish brown (10YR 5/2) mottles; weak fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

B1—13 to 19 inches; brown (10YR 5/3) sandy loam; many medium distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; few fine roots; many soft dark brown (7.5YR 4/4) iron and manganese oxide accumulations; slightly acid; clear wavy boundary.

B21tg—19 to 30 inches; light brownish gray (10YR 6/2) loam; many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; thin patchy gray (10YR 5/1) clay films on peds; medium continuous light gray (10YR 7/1) silt coatings on peds; common black (10YR 2/1) iron and manganese oxide accumulations; medium acid; clear wavy boundary.

B22tg—30 to 45 inches; gray (10YR 6/1) clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate coarse subangular blocky; firm; thin continuous gray (5Y 6/1) clay films; thin discontinuous light gray (10YR 7/2) silt coatings on peds; slightly acid; gradual wavy boundary.

B23tg—45 to 52 inches; gray (10YR 6/1) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin discontinuous light gray (10YR 7/2) clay and silt coatings on peds; 3 percent gravel; slightly acid.

C—52 to 60 inches; grayish brown (10YR 5/2) loam; massive; friable; strong effervescence; moderately alkaline.

The solum is 38 to 60 inches thick. Calcareous material is below the solum. The sandy loam upper layers are 18 to 36 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). It is loamy sand or sandy loam. The A2 horizon is light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or brown (10YR 5/3). It is loamy sand or sandy loam and is medium acid to neutral.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 5. It is loam, sandy clay loam, or clay loam. It is medium acid or strongly acid in the upper part and ranges from medium acid to neutral in the lower part.

The C horizon is loam, silt loam, or clay loam.

Brady series

The Brady series consists of deep, somewhat poorly drained soils on outwash plains. Permeability is moderately rapid in the solum and rapid in the substratum. These soils formed in loamy and sandy glacial outwash. Slope ranges from 0 to 2 percent.

Brady soils are similar to Bronson soils and are commonly near Gilford, Pinhook, and Oshtemo soils. Bronson soils do not have a dark surface layer. Gilford and Pinhook soils have a gray subsoil and are in lower positions. Oshtemo soils have a brown subsoil that is not mottled with gray and are in higher positions.

Typical pedon of Brady sandy loam, in a cultivated field, 1,200 feet south and 175 feet east of the northwest corner of sec. 20, T. 35 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 5/3) dry; moderate medium granular structure; very friable; common fine roots; 2 percent gravel; strongly acid; abrupt smooth boundary.

B21t—9 to 14 inches; brown (10YR 5/3) sandy loam; common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; common fine roots; thin discontinuous dark brown (10YR 4/3) clay bridges between sand grains; 2 percent gravel; strongly acid; clear wavy boundary.

B22t—14 to 20 inches; yellowish brown (10YR 5/4) sandy loam; many medium distinct yellowish brown (10YR 5/8) and common medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay bridges between sand grains; 2 percent gravel; strongly acid; clear wavy boundary.

B23t—20 to 36 inches; light brownish gray (10YR 6/2) sandy loam; many fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous yellowish brown (10YR 5/4) clay bridges between sand grains; strongly acid; clear wavy boundary.

B3—36 to 48 inches; light brownish gray (10YR 6/2) loamy sand; common coarse prominent dark reddish brown (5YR 3/4) mottles; weak coarse subangular blocky structure; very friable; medium acid; gradual wavy boundary.

C—48 to 60 inches; brown (10YR 5/3) stratified sand and gravelly coarse sand; many medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; medium acid.

The solum is 40 to 50 inches thick.

The A1 horizon, where present, is very dark gray (10YR 3/1) or black (10YR 2/1) sandy loam. The Ap horizon is very dark gray (10YR 3/l), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2) sandy loam or loamy sand.

The B21 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam, gravelly sandy loam, sandy clay loam, gravelly sandy clay loam, and loam. It is strongly acid or medium acid. The B22t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It has the same texture and reaction as the B21 horizon. The B23t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4.

The C horizon is grayish brown (10YR 5/2), brown (10YR 5/3), or gray (10YR 5/1). It is medium acid or slightly acid.

Brems series

The Brems series consists of deep, moderately well drained, rapidly permeable soils on outwash plains. These soils formed in sand and fine sand. Slope ranges from 0 to 2 percent. These soils are taxadjuncts to the Brems series because they do not have mottles with chroma of 2 or less in the upper 40 inches. This difference does not alter the usefulness or behavior of these soils.

Brems soils are commonly near Chelsea, Gilford, and Plainfield soils. Chelsea soils have a brown subsoil and have thin bands in the B horizon above a depth of 60 inches; they are in higher positions. Gilford soils have a mollic epipedon, have more clay in the subsoil, and are gray throughout the subsoil; they are in undefined drainageways. Plainfield soils are brown throughout the subsoil and are in higher positions.

Typical pedon of Brems sand, 0 to 2 percent slopes, in a cultivated area, 2,460 feet east and 820 feet south of the northwest corner of sec. 30, T. 34 N., R. 1 E.

Ap—0 to 8 inches; dark brown (10YR 4/3) sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

A2—8 to 14 inches; brown (10YR 5/3) sand; weak fine granular structure; very friable; common fine roots; strongly acid; clear wavy boundary.

B21—l4 to 24 inches; yellowish brown (10YR 5/4) sand; common fine distinct brownish yellow (10YR 6/8) and few fine distinct strong brown (7.5YR 5/6) mottles; single grain; loose; strongly acid; clear wavy boundary.

B22—24 to 30 inches; light yellowish brown (10YR 6/4) sand; common medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; strongly acid; clear wavy boundary.

B23—30 to 42 inches; light yellowish brown (10YR 6/4) sand; common medium distinct strong brown (7.5YR 6/8) mottles; single grain; loose; common soft dark brown (7.5YR 3/2) iron and manganese oxide accumulations; medium acid; gradual wavy boundary.

B3—42 to 48 inches; strong brown (7.5YR 5/6) sand; many medium distinct very pale brown (10YR 7/3) mottles; single grain; loose; medium acid; gradual wavy boundary.
C—48 to 60 inches; light yellowish brown (10YR 6/4) sand; many medium distinct brownish yellow (10YR 6/8) and strong brown (7.5YR 5/6) mottles; single grain; loose; medium acid.

The solum is 35 to 60 inches thick.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is sand, loamy sand, or fine sand. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3. The B2 horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 8 and is mottled. Mottles with chroma of 2 or less are at a depth of more than 40 inches.

The B2 horizon is sand, fine sand, or loamy sand and is medium acid to very strongly acid.

The C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 to 8 and is sand or fine sand. The C horizon is mottled and is medium acid or strongly acid.

Bronson series

The Bronson series consists of deep, moderately well drained soils on outwash plains. Permeability is moderately rapid in the subsoil and very rapid in the substratum. These soils formed in sandy and loamy glacial outwash. Slope ranges from 0 to 2 percent.

Bronson soils are similar to Brady soils and are commonly near Gilford, Pinhook, and Oshtemo soils. Brady soils have a dark surface layer. Gilford and Pinhook soils have a gray subsoil and are in lower positions. Oshtemo soils have a brown subsoil that is not mottled and are in higher positions.

Typical pedon of Bronson loamy sand, 0 to 2 percent slopes, in a cultivated field, 2,200 feet west and 200 feet north of the southeast corner of sec. 9, T. 32 N., R. 4 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loamy sand, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; few fine roots; strongly acid; abrupt smooth boundary.
A2—10 to 14 inches; brown (10YR 5/3) loamy sand; weak thick platy structure; very friable; few fine roots; few dark yellowish brown (10YR 4/4) iron and manganese oxide accumulations; medium acid; clear wavy boundary.
B1—14 to 24 inches; brown (10YR 5/3) sandy loam; weak medium subangular blocky structure; friable; few fine roots; 4 percent gravel; many brown (10YR 4/4) iron and manganese oxide accumulations; strongly acid; gradual wavy boundary.
B2t—24 to 36 inches; brown (10YR 5/3) sandy loam; common fine faint light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark yellowish brown (10YR 4/6) clay coatings on and bridges between sand grains; many brown (10YR 4/4) iron and manganese oxide accumulations; 5 percent gravel; strongly acid; gradual wavy boundary.
B3—36 to 46 inches; light brownish gray (10YR 6/2) and dark yellowish brown (10YR 4/4) loamy sand; mottled; weak coarse subangular blocky structure; very friable; common black (10YR 2/1) iron and manganese oxide accumulations; 8 percent gravel; slightly acid; gradual wavy boundary.
C—46 to 60 inches; light brownish gray (10YR 6/2) stratified coarse sand and fine gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The solum is 40 to 55 inches thick.

The A1 horizon, where present, is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), grayish brown (10YR 5/2), or brown (10YR 5/3). It is loamy sand or sandy loam. The A2 is brown (10YR 5/3) or yellowish brown (10YR 5/4). It has the same texture as the Ap horizon.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4 and is mottled. It is sandy loam or gravelly sandy loam and is strongly acid or medium acid.

The C horizon is stratified coarse sand, fine gravelly sand, or very gravelly sand. It is slighty acid to moderately alkaline.

Brookston series

The Brookston series consists of deep, very poorly drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slope ranges from 0 to 2 percent.

Brookston soils are similar to Milford and Rensselaer soils and are near Crosier and Riddles soils. Milford soils have more clay in the subsoil. Rensselaer soils have stratification in the lower part of the solum and in the substratum. Crosier and Riddles soils do not have a mollic epipedon and are in higher positions.

Typical pedon of Brookston loam, in a cultivated field, 400 feet east and 1,700 feet north of the southwest corner of sec. 29, T. 34 N., R. 4 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium granular structure; firm; neutral; abrupt smooth boundary.
A12—10 to 14 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; 3 percent gravel; neutral; clear wavy boundary.
B21tg—14 to 22 inches; dark gray (10YR 4/1) clay loam; common fine distinct yellowish brown (10YR 5/6)

mottles; moderate medium subangular blocky structure; firm; 3 percent gravel; thin discontinuous dark gray (10YR 4/1) clay films on peds; few fine distinct dark reddish brown (5YR 3/2) iron and manganese oxide accumulations; neutral; clear wavy boundary.

B22tg—22 to 36 inches; gray (10YR 5/1) clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; 3 percent gravel; thin discontinuous very dark gray (10YR 3/1) clay films on peds; neutral; gradual wavy boundary.

B23tg—36 to 42 inches; light gray (10YR 6/1) silty clay loam; moderate medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; 3 percent gravel; thin discontinuous very dark gray (10YR 3/l) clay films on peds; neutral; gradual wavy boundary.

B24tg—42 to 48 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; 2 percent gravel; thin discontinuous gray (10YR 6/1) silt coatings on peds; 2 percent fine gravel; neutral; clear wavy boundary.

C—48 to 60 inches; brown (10YR 5/3) loam; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline.

The solum is 34 to 55 inches thick and is slightly acid or neutral.

The Ap horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), black (10YR 2/1), or very dark brown (10YR 2/2) loam or clay loam.

The B2t horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2; or it is neutral with value of 4 to 6 and is mottled. The upper part of the B2t horizon is silty clay loam or clay loam. The lower part of the B2t horizon is clay loam or loam and contains 1 to 10 percent gravel.

The C horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4 and 5/6) loam or clay loam. It is mildly alkaline or moderately alkaline.

Chelsea series

The Chelsea series consists of deep, excessively drained, rapidly permeable soils on outwash plains. These soils formed in sandy sediment or sand reworked by wind. Slope ranges from 2 to 12 percent.

Chelsea soils are similar to Plainfield and Tyner soils and are near Metea and Oshtemo soils. Plainfield and Tyner soils do not have thin bands in the B horizon above a depth of 60 inches. Metea soils have more clay in the lower part of the solum and in the substratum. Oshtemo soils have more clay in the solum.

Typical pedon of Chelsea fine sand, 2 to 6 percent slopes, in a cultivated field, 1,330 feet west and 1,500 feet north of the southeast corner of Michigan Road Land sec. 16, T. 33 N., R, 2 E.

Ap—0 to 7 inches; dark brown (10YR 3/3) fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine roots; medium acid; abrupt smooth boundary.

A21—7 to 10 inches; dark brown (10YR 4/3) fine sand; single grain; loose; few fine roots; slightly acid; clear wavy boundary.

A22—10 to 34 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; few fine and medium roots; slightly acid; gradual wavy boundary.

1A&B—34 to 80 inches; light yellowish brown (10YR 6/4) fine sand (A part); single grain; loose; and bands of dark brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) loamy sand (B part); massive; very friable; bands are 1/2 to 2 inches thick and have a total thickness of less than 6 inches above a depth of 60 inches; clay bridges connect sand grains in the bands; few fine roots; slightly acid.

The solum is 5 to 8 feet thick and is slightly acid to strongly acid.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is fine sand or loamy fine sand. The A2 horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6.

The A part of the A&B horizon has hue of 10YR, value of 5 or 6, and chroma of 4. The B part has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 4 and is loamy sand or sandy loam.

Crosier series

The Crosier series consists of deep, somewhat poorly drained, moderately slowly permeable soils on uplands. These soils formed in loamy glacial till. Slope ranges from 0 to 2 percent.

Crosier soils are similar to Aubbeenaubbee and Whitaker soils and are near Brookston and Riddle soils. Aubbeenaubbee soils contain more sand in the upper part of the solum. Whitaker soils are stratified in the substratum. Brookston soils have a mollic epipedon, have a predominantly gray subsoil, and are in low areas. Riddles soils have a brown subsoil and are in higher positions.

Typical pedon of Crosier loam, 0 to 2 percent slopes, in a cultivated field, 300 feet west and 1,340 feet south of the northeast corner of sec. 4, T. 34 N., R. 4 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam; light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—9 to 12 inches; grayish brown (10YR 5/2) loam; weak fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

B21t—12 to 18 inches; grayish brown (10YR 5/2) clay loam; few fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky

structure; firm; thin discontinuous dark gray (10YR 4/1) clay films on peds; slightly acid; clear wavy boundary.

B22t—18 to 26 inches; brown (10YR 5/3) clay loam; many common distinct brownish yellow (10YR 6/8) mottles; moderate coarse subangular blocky structure; firm; thin discontinuous dark gray (10YR 4/1) clay films on peds; slightly acid; clear wavy boundary.

C—26 to 60 inches; brown (10YR 5/3) loam; many common distinct yellowish brown (10YR 5/8) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum is 24 to 35 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A1 horizon, where present, is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark gray (10YR 4/1). It is loam, silt loam, or sandy loam. The A2 horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2) and has the same texture as the Ap horizon.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6 and is mottled throughout. The B2t horizon is clay loam, loam, or sandy clay loam. The upper part is strongly acid to slightly acid, and the lower part is medium acid to neutral.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 or 4 and is mottled. The C horizon is loam or sandy loam.

Edwards series

The Edwards series consists of deep, very poorly drained soils in bogs and old lakebeds on till plains, moraines, and outwash plains. Permeability is moderately slow to moderately rapid in the organic material and variable in the underlying marl. These soils formed in organic deposits over marl. Slope ranges from 0 to 2 percent.

Edwards soils are similar to Adrian, Houghton, and Palms soils. Adrian soils formed in 16 to 51 inches of muck over sand. Houghton soils have more than 51 inches of muck. Palms soils formed in 16 to 51 inches of muck over loamy material.

Typical pedon of Edwards muck, drained, in a cultivated field, 2,940 feet west and 220 feet north of the southeast corner of sec. 32, T. 33 N., R. 3 E.

Oap—0 to 9 inches; black (10YR 2/1) broken face and rubbed sapric material, very dark gray (10YR 3/1) dry; less than 5 percent fiber, less than 2 percent rubbed; moderate fine granular structure; friable; many fine roots; mostly herbaceous fiber; strong effervescence; mildly alkaline; abrupt smooth boundary.

Oa2—9 to 14 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fiber, less than 2 percent rubbed; weak coarse subangular blocky structure; friable; common fine roots; primarily herbaceous fiber; strong effervescence; mildly alkaline; clear smooth boundary.

Oa3—14 to 20 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material; less than 5 percent fiber, less than 2 percent rubbed; weak medium platy structure; friable; few fine roots; primarily herbaceous fiber; strong effervescence; mildly alkaline; abrupt wavy boundary.

IILca—20 to 60 inches; light brownish gray (10YR 6/2) marl; massive; friable; common white (10YR 8/1) shells; violent effervescence; moderately alkaline.

The depth to the Lca horizon is 16 to 40 inches. The organic material is mostly herbaceous.

The surface tier is very dark brown (10YR 2/2) or black (10YR 2/1, N 2/0) sapric material. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR; value of 2 or 3; and chroma of 7 to 3 or are neutral and have value of 2 or 3. They are sapric material. The upper part of the organic material is medium acid to mildly alkaline, and the lower part is slightly acid to moderately alkaline.

The IILca horizon has hue of 10YR, value 5 to 8, and chroma of 1 or 2.

Elston series

The Elston series consists of deep, well drained soils on outwash plains. Permeability is moderately rapid in the solum and very rapid in the substratum. These soils formed in glacial outwash. Slope ranges from 0 to 2 percent. These soils are taxadjuncts to the Elston series because they have too many coarse fragments in the lower part of the solum and in the substratum. This difference does not alter the usefulness or behavior of the soils.

Elston soils are similar to Oshtemo soils and are near Fox and Troxel soils. Fox and Oshtemo soils do not have a mollic epipedon. Troxel soils contain more silt and less sand and have a dark surface layer at least 24 inches thick.

Typical pedon of Elston sandy loam, 0 to 2 percent slopes, in a cultivated field, 600 feet west and 640 feet north of the center of sec. 32, T. 33 N., R. 1 E.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A12—9 to 14 inches; very dark grayish brown (10YR 3/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak medium granular structure; friable; few fine roots; medium acid; clear wavy boundary.

B21t—14 to 24 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; thin patchy dark grayish

brown (10YR 4/2) clay bridges between sand grains and around pebbles; 5 percent gravel; medium acid; clear wavy boundary.
IIB22t—24 to 32 inches; dark brown (7.5YR 4/4) gravelly sandy loam; weak medium subangular blocky structure; friable; thin patchy dark grayish brown (10YR 4/2) clay bridges between sand grains and around pebbles; 30 percent gravel; medium acid; gradual wavy boundary.
IIB23—32 to 45 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak coarse subangular blocky structure; very friable; 20 percent gravel; medium acid; gradual wavy boundary.
IIB3—45 to 53 inches; dark brown (10YR 4/3) gravelly loamy sand; weak coarse subangular blocky structure; very friable; 30 percent gravel; neutral; clear wavy boundary.
IIC—53 to 60 inches; brown (10YR 5/3) stratified coarse sand and gravelly sand; single grain; loose; 30 percent gravel; slight effervescence; mildly alkaline.

The solum is 42 to 60 inches thick. The sand throughout the solum is dominantly medium, coarse, and very coarse.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It typically is sandy loam or loam. It has moderate or weak, medium, granular structure or weak, medium or coarse, subangular blocky structure. It is neutral to strongly acid.

The B2t horizon and IIB2t horizons have hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 or 4. They are loamy sand, sandy loam, loam, sandy clay loam, and the gravelly analogs of these textures. Gravel content ranges from 5 to 35 percent. Reaction is medium acid to very strongly acid in the upper part and strongly acid to slightly acid in the lower part.

The C horizon is slightly acid to moderately alkaline.

Fox series

The Fox series consists of well drained soils on outwash plains and moraines. These soils are moderately deep over sand or gravelly sand. Permeability is moderate in the subsoil and rapid in the substratum. These soils formed in loamy deposits over sand or gravelly sand. Slope ranges from 0 to 12 percent.

Fox soils are commonly near Oshtemo and Riddles soils. Oshtemo soils have less clay in the subsoil. Riddles soils contain less gravel and sand in the subsoil and substratum.

Typical pedon of Fox sandy loam, 2 to 6 percent slopes, in a cultivated area, 1,000 feet east and 150 feet north of the southwest corner of sec. 4, T. 32 N., R. 1 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; 8 percent gravel; medium acid; abrupt smooth boundary.
A2—9 to 12 inches; brown (10YR 5/3) sandy loam; weak thick platy structure parting to weak medium granular; friable; 8 percent gravel; medium acid; clear smooth boundary.
B21t—12 to 25 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous dark brown (7.5YR 3/2) clay films on peds; 8 percent gravel; neutral; clear wavy boundary.
B22t—25 to 35 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; thin discontinuous dark brown (7.5YR 3/2) clay films on peds; neutral; clear irregular boundary.
IIC—35 to 60 inches; brown (10YR 5/3) gravelly sand; single grain; loose; 30 percent gravel; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. It is slightly acid or medium acid in the upper part and neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is sandy loam or loam. Where undisturbed the soil has a very dark grayish brown (10YR 3/2) A1 horizon less than 4 inches thick. The A2 horizon has hue of 10YR, value of 5, and chroma of 2 or 3 and is sandy loam or loam.

The B2t horizon has hue of 5YR, 7.5YR, or 10YR; value of 3 or 4; and chroma of 3 to 5. It is clay loam, sandy clay loam, loam, and gravelly analogs of these textures.

The IIC horizon has hue of 10YR, value of 5 to 7, and chroma of 2 to 4. It is sand, coarse sand, or gravelly sand.

Gilford series

The Gilford series consists of deep, very poorly drained soils on outwash plains. Permeability is moderately rapid in the solum and rapid in the substratum. These soils formed in loamy and sandy glacial outwash. Slope ranges from 0 to 2 percent.

Gilford soils are similar to Pinhook soils and are commonly near Brady and Bronson soils. Pinhook soils have a dark surface layer less than 10 inches thick. Brady and Bronson soils have a brown subsoil mottled with chroma of 2 and are in higher positions.

Typical pedon of Gilford sandy loam, in a cultivated field, 500 feet east and 2,000 feet north of the southwest corner of sec. 4, T. 34 N., R. 1 E.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak medium granular structure; very friable; common fine roots; medium acid; abrupt smooth boundary.
A12—10 to 14 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

B21g—14 to 24 inches; dark gray (10YR 4/1) sandy loam; weak medium subangular blocky structure; friable; few fine roots; many common coarse strong brown (7.5YR 5/8) iron and manganese oxide stains; slightly acid; clear smooth boundary.
B22g—24 to 30 inches; grayish brown (10YR 5/2) loamy sand; few fine faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very friable; neutral; clear smooth boundary.
Cg—30 to 60 inches; gray (10YR 5/1) sand; single grain; loose; neutral.

The solum is 25 to 35 inches thick. The mollic epipedon is 10 to 17 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 2. It is sandy loam, fine sandy loam, or loamy sand and is medium acid to neutral.

The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam or fine sandy loam. It has thin subhorizons of loam, sandy clay loam, and loamy sand. It is slightly acid to neutral.

The C horizon is sand or gravelly sand. It is neutral or mildly alkaline.

Hillsdale series

The Hillsdale series consists of deep, well drained, moderately permeable soils on moraines. These soils formed in loamy glacial till. Slope ranges from 2 to 6 percent.

Hillsdale soils are similar to Oshtemo, Riddles, and Wawasee soils and are commonly near Aubbeenaubbee soils. Riddles and Wawasee soils contain more clay throughout the solum. Oshtemo soils contain more sand and coarse fragments in the lower part of the solum and in the substratum. Aubbeenaubbee soils contain more clay in the lower part of the solum, have mottles with chroma of 2 in the subsoil, and are in lower positions.

Typical pedon of Hillsdale sandy loam, 2 to 6 percent slopes, in a cultivated field, 550 feet south and 1,800 feet west of the northeast corner of sec. 32, T. 33 N., R. 3 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.
A2—9 to 14 inches; brown (10YR 5/3) sandy loam; weak fine granular structure; friable; common fine roots; slightly acid; clear wavy boundary.
B21—14 to 28 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine and medium subangular blocky structure; friable; few fine roots; 8 percent fine gravel; slightly acid; gradual wavy boundary.
B22t—28 to 36 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin patchy dark brown (10YR 3/3) clay films on peds and bridges between sand grains; 5 percent fine gravel; slightly acid; gradual wavy boundary.
B23t—36 to 46 inches; brown (7.5YR 5/4) sandy loam; moderate medium subangular blocky structure; friable; thin patchy dark brown (10YR 4/3) clay films on peds and bridges between sand grains; 6 percent fine gravel; slightly acid; gradual wavy boundary.
B3—46 to 50 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse subangular blocky structure; friable; 5 percent fine gravel; neutral; gradual wavy boundary.
C—50 to 60 inches; brown (10YR 5/3) sandy loam; massive; friable; 5 percent fine gravel; slight effervescence; mildly alkaline.

The solum is 40 to 55 inches thick. This thickness usually coincides with the depth to free carbonates.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. The A horizon is sandy loam, fine sandy loam, loam, or loamy sand.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3, 4, or 6. It is sandy loam with individual horizons less than 10 inches thick of loam or sandy clay loam. The upper part is slightly acid to very strongly acid, and the lower part is medium acid to slightly acid.

The C horizon is brown (10YR 5/3), yellowish brown (10YR 5/4), or light yellowish brown (10YR 6/4) sandy loam or loamy sand and is mildly alkaline or moderately alkaline.

Houghton series

The Houghton series consists of deep, very poorly drained, moderately slowly to moderately rapidly permeable soils in bogs and old lakebeds on till plains, moraines, and outwash plains. These soils formed in organic deposits. Slope ranges from 0 to 2 percent.

Houghton soils are similar to Adrian, Edwards, and Palms soils. All of those soils have organic layers 16 to 51 inches thick. Adrian soils developed in muck over sand. Edwards soils developed in muck over marl. Palms soils developed in muck over loamy material.

Typical pedon of Houghton muck, drained, in a cultivated field, 270 feet west and 60 feet north of the southeast corner of sec. 32, T. 33 N., R. 4 E.

Oap—0 to 9 inches; black (N 2/0) broken face and rubbed sapric material, black (N 2/0) dry; 8 percent fiber, 2 percent rubbed; weak medium granular structure; very friable; many fine roots; primarily herbaceous fiber; medium acid; abrupt smooth boundary.
Oa2—9 to 18 inches; black (N 2/0) broken face and rubbed sapric material; 25 percent fiber, 8 percent rubbed; moderate medium subangular blocky structure; friable; common fine roots; primarily herbaceous fiber; slightly acid; clear wavy boundary.

Oa3—18 to 30 inches; black (N 2/0) broken face and rubbed sapric material; 30 percent fiber, 5 percent rubbed; massive; friable; few fine roots; primarily herbaceous fiber; slightly acid; gradual wavy boundary.
Oa4—30 to 50 inches; black (10YR 2/1) broken face and rubbed sapric material; 35 percent fiber, 6 percent rubbed; massive; friable; primarily herbaceous fiber; slightly acid; clear wavy boundary.
Oa5—50 to 60 inches; black (10YR 2/1) broken face and rubbed sapric material; 15 percent fiber, 6 percent rubbed; massive; friable; primarily herbaceous fiber; slightly acid.

The organic layer is more than 51 inches thick. The organic materials are mostly herbaceous.

The organic material in the control section has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3; or it is neutral and has value of 2 or 3. The upper part of the control section is strongly acid to neutral, and the lower part is medium acid to neutral. The underlying organic material is basically the same as the control section but contains less fiber.

Linkville series

The Linkville series consists of deep, well drained soils on ground moraines and outwash plains. Permeability is moderate in the subsoil and rapid in the substratum. These soils formed in loamy glacial till over stratified sand and gravelly sand. Slope ranges from 0 to 6 percent.

Linkville soils are similar to Riddles soils and are near Oshtemo and Troxel soils. Riddles soils do not have a mollic epipedon. Oshtemo soils contain more sand throughout the solum. Troxel soils are in depressions and have a mollic epipedon more than 24 inches thick.

Typical pedon of Linkville sandy loam, 0 to 2 percent slopes, in a cultivated field, 560 feet west and 800 feet north of the southeast corner of sec. 2, T. 33 N., R. 2 E.

Ap—0 to 10 inches; very dark brown (10YR 2/2) sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; neutral; clear smooth boundary.
A12—10 to 13 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; common fine roots; common fine pores; common continuous distinct medium very dark brown (10YR 2/2) organic coatings on peds; common discontinuous distinct thin brown (10YR 5/3) silt coatings on peds; 2 percent gravel; neutral; clear smooth boundary.
B1—13 to 18 inches; dark brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; common very fine roots; few medium pores; common discontinuous pale brown (10YR 6/3) coatings on faces of peds; 2 percent gravel; medium acid; clear wavy boundary.
B21t—18 to 27 inches; yellowish brown (10YR 5/4) loam; moderate fine and medium subangular blocky structure; firm; few very fine roots; few medium and common fine pores; thin patchy dark brown (10YR 4/3) clay films on peds; 2 percent gravel; strongly acid; gradual wavy boundary.
B22t—27 to 45 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; firm; few very fine roots; few medium and common fine pores; medium discontinuous very dark grayish brown (10YR 3/2) clay films on peds; 2 percent gravel; strongly acid; gradual wavy boundary.
B23t—45 to 66 inches; yellowish brown (10YR 5/4) loam; moderate medium and coarse subangular blocky structure; friable; common fine pores; very dark grayish brown (10YR 3/2) clay coatings in pores and along root channels; 2 percent gravel; strongly acid; gradual irregular boundary.
IIB3t—66 to 77 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; few patchy very dark grayish brown (10YR 3/2) clay bridges between sand grains and pebbles; 25 percent gravel; slightly acid; clear irregular boundary.
IIIC—77 to 80 inches; stratified brown (10YR 5/3) sand and gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The solum is 48 to 96 inches thick. The depth to free carbonates usually coincides with this thickness. The solum contains 1 to 10 percent gravel except in the B3 horizon, which contains as much as 30 percent.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is sandy loam, silt loam, or loam. The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 5, and chroma of 3 to 6. The B2t horizon is dominantly loam, but some subhorizons are sandy loam, sandy clay loam, or clay loam. The upper part is medium acid or strongly acid, and the lower part is slightly acid to strongly acid.

The proportions of sand and gravel range widely in the IIIC horizon.

Martinsville series

The Martinsville series consists of deep, well drained, moderately permeable soils on terraces and outwash plains. These soils formed in stratified loamy material. Slope ranges from 0 to 12 percent.

Martinsville soils are similar to Riddles soils and are near Oshtemo, Rensselaer, and Whitaker soils. Riddles soils are not stratified in the lower part of the solum and in the underlying material. Oshtemo soils contain more sand throughout the solum. Rensselaer soils have a mollic epipedon and a gray subsoil and are in undefined

drainageways. Whitaker soils are mottled in the subsoil and are in lower positions.

Typical pedon of Martinsville loam, 2 to 6 percent slopes, in a cultivated field, 1,440 feet west and 120 feet south of the northeast corner of sec. 8, T. 34 N., R. 3 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.
A2—8 to 11 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure parting to moderate medium granular; continuous distinct light gray (10YR 6/1) silt coatings on peds; medium acid; clear smooth boundary.
B21t—11 to 18 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; thin discontinuous clay films on peds; medium acid; gradual wavy boundary.
B22t—18 to 31 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous dark brown (10YR 4/3) clay films on peds; medium acid; gradual wavy boundary.
B23t—31 to 37 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate coarse subangular blocky structure; firm; thin discontinuous dark brown (10YR 4/3) clay films on peds and bridges between sand grains; medium acid; clear wavy boundary.
B3—37 to 53 inches; dark yellowish brown (10YR 4/4) sandy loam with a thin stratum of sandy clay loam; weak coarse subangular blocky structure; friable; medium acid; gradual wavy boundary.
IIC1—53 to 75 inches; yellowish brown (10YR 5/4) stratified sandy loam, loamy sand, and silt loam; massive; friable; medium acid; gradual wavy boundary.
IIC2—75 to 80 inches; yellowish brown (10YR 5/4) stratified silt loam and sandy loam; massive; friable; strong effervescence; moderately alkaline.

The solum is 36 to 60 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is commonly loam or sandy loam.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, clay loam, sandy clay loam, or silty clay loam. It is strongly acid or medium acid in the upper part and medium acid to neutral in the lower part.

The C horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4).

Metea series

The Metea series consists of deep, well drained soils on moraines. Permeability is very rapid in the upper part of the solum and moderate in the substratum. These soils formed in water- or wind-laid sands over loamy glacial till. Slope ranges from 2 to 12 percent.

Metea soils are near Aubbeenaubbee, Chelsea, Owosso, and Riddles soils. Aubbeenaubbee soils contain mottles with chroma of 2 throughout the solum and are in lower positions. Chelsea soils contain more sand in the lower part of the solum. Owosso and Riddles soils contain more clay in the upper part of the solum.

Typical pedon of Metea loamy fine sand, 2 to 6 percent slopes, in a cultivated field, 1,600 feet west and 700 feet south of the center of sec. 25, T. 33 N., R. 1 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) loamy fine sand, light yellowish brown (10YR 6/4) dry; weak fine granular structure; very friable; medium acid; abrupt smooth boundary.
B21—9 to 28 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; medium acid; gradual wavy boundary.
B22t—28 to 32 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; friable; common brown (10YR 4/3) clay bridges between sand grains; 3 percent gravel; medium acid; clear wavy boundary.
IIB23t—32 to 44 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films on peds; 4 percent gravel; medium acid; clear wavy boundary.
IIC—44 to 60 inches; brown (10YR 5/3) loam; massive; friable; strong effervescence; moderately alkaline.

The solum is 36 to 55 inches thick. The thickness of the sandy upper horizons is 20 to 40 inches.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is loamy sand, loamy fine sand, or sand and is neutral to medium acid. The A1 horizon, where present, is very dark gray (10YR 3/1) or dark grayish brown (10YR 3/2).

The B2 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is loamy sand, loamy fine sand, fine sand, or sand. It is neutral to strongly acid. The IIB2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 8. It is clay loam or sandy clay loam with layers of loam and sandy loam. The upper part of the IIB horizon is medium acid or slightly acid and the lower part is medium acid to moderately alkaline.

The IIC horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4 to 5/8).

Milford series

The Milford series consists of deep, very poorly drained, moderately slowly permeable soils on glacial lakebeds. These soils formed in lacustrine material. Slope ranges from 0 to 2 percent.

Milford soils are similar to Brookston and Rensselaer soils and are commonly near Crosier and Whitaker soils. Brookston and Rensselaer soils have less clay in the subsoil. Rensselaer soils contain stratification in the

lower part of the solum and in the substratum. Crosier and Whitaker soils do not have a mollic epipedon, have a predominantly brown horizon in the subsoil, and are in higher positions.

Typical pedon of Milford silty clay loam, in a cultivated field, 1,800 feet east and 1,200 feet south of the northwest corner of sec. 35, T. 34 N., R. 3 E.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; common roots; neutral; abrupt smooth boundary.

A12g—9 to 13 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; common fine distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; common fine roots; neutral; clear smooth boundary.

B21g—13 to 18 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very firm; neutral; clear wavy boundary.

B22g—18 to 28 inches; gray (10YR 5/1) silty clay; moderate medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse angular blocky structure; very firm; pockets of loam 2 inches thick at 24 to 26 inches; neutral; gradual wavy boundary.

B23g—28 to 38 inches; gray (10YR 5/1) silty clay; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate coarse angular blocky; very firm; neutral; clear wavy boundary.

B3g—38 to 42 inches; gray (10YR 5/1) silty clay; common medium distinct brownish yellow (10YR 6/6) mottles; moderate medium prismatic structure; very firm; slight effervescence; mildly alkaline; clear wavy boundary.

Cg—42 to 60 inches; dark gray (10YR 4/1) silty clay loam; many coarse distinct brown (7.5YR 4/4) mottles; massive; very firm; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. The mollic epipedon is 12 to 16 inches thick.

The A1 or Ap horizon is black (10YR 2/1, N 2/0, 5Y 2/1, 5Y 2/2) or very dark gray (N 3/0, 5Y 3/1).

The B2g horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 to 6; and chroma of 1 or 2 or is neutral and has value of 4 to 6. Mottles are common or many and distinct or prominent. The B2g horizon is slightly acid or neutral.

The C horizon is stratified lakebed sediments, mainly clay loam or silty clay loam, and often contain thin layers of sandy loam to clay. It is neutral to moderately alkaline.

Newton series

The Newton series consists of deep, very poorly drained, rapidly permeable soils on moraines and outwash plains. These soils formed in strongly acid and very strongly acid sandy sediments. Slope ranges from 0 to 2 percent.

Newton soils are commonly near Brems, Chelsea, and Plainfield soils. Brems soils have a predominantly brown subsoil that has mottles with chroma of 2 and are in lower positions. Chelsea and Plainfield soils have a brown subsoil.

Typical pedon of Newton loamy fine sand, in a cultivated field, 2,350 feet north and 500 feet east of the southwest corner of sec. 19, T. 33 N., R. 1 E.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

A12—10 to 15 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine roots; strongly acid; clear smooth boundary.

A13—15 to 22 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; strongly acid; gradual wavy boundary.

C1g—22 to 30 inches; grayish brown (10YR 5/2) sand; common medium distinct very dark grayish brown (10YR 3/2) mottles; single grain; loose; strongly acid; gradual wavy boundary.

C2g—30 to 42 inches; grayish brown (2.5Y 5/2) sand; common medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; strongly acid; gradual wavy boundary.

C3g—42 to 60 inches; light brownish gray (2.5Y 6/2) sand; common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; strongly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A horizon is typically loamy fine sand but ranges to loamy sand, sand, sandy loam, and fine sandy loam. It is medium acid or strongly acid.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The C horizon has mottles with chroma of 1 to 8 because of iron segregation. The C horizon is strongly acid or very strongly acid.

Oshtemo series

The Oshtemo series consists of deep, well drained soils on moraines and outwash plains. Permeability is moderately rapid in the solum and very rapid in the substratum. These soils formed in loamy and sandy glacial drift. Slope ranges from 0 to 18 percent.

Oshtemo soils are similar to Hillsdale soils and are commonly near Brady, Bronson, and Fox soils. Hillsdale soils contain less sand and gravel in the lower part of the solum and in the substratum. Brady and Bronson soils have mottles with chroma of 2 in the subsoil and are in lower positions. Fox soils contain more clay throughout the solum.

Typical pedon of Oshtemo loamy sand, 0 to 2 percent slopes, in a cultivated field, 200 feet west and 900 feet south of the northeast corner of sec. 31, T. 33 N., R. 1 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loamy sand; pale brown (10YR 6/3) dry; weak medium granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.
A2—9 to 14 inches; yellowish brown (10YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; 5 percent gravel; neutral; clear smooth boundary.
B21t—14 to 24 inches; dark brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; friable; few fine roots; thin discontinuous reddish brown (5YR 4/4) clay films on peds and bridges between sand grains; 8 percent gravel; medium acid; clear wavy boundary.
B22t—24 to 36 inches; dark brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; thin discontinuous reddish brown (5YR 4/4) clay films on peds and bridges between sand grains; 12 percent gravel; medium acid; clear wavy boundary.
B31—36 to 45 inches; strong brown (7.5YR 5/6) gravelly loamy sand; weak fine subangular blocky structure; very friable; 20 percent gravel; medium acid; gradual wavy boundary.
B32—45 to 50 inches; very dark grayish brown (10YR 3/2) gravelly loamy sand; weak coarse subangular blocky structure; very friable; 22 percent gravel; neutral; gradual wavy boundary.
C—50 to 60 inches; brown (10YR 5/3) stratified gravelly sand and coarse sand; single grain; loose; 25 percent gravel; strong effervescence; moderately alkaline.

The solum is 40 to 56 inches thick.

The A1 horizon, where present, is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) loamy sand or sandy loam. The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or brown (10YR 5/3) and is loamy sand or sandy loam. The A2 horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4, 5/6). It has the same texture as the Ap horizon.

The B2t horizon has hue of 5YR, 7.5YR, or 10YR; value of 3 to 5; and chroma of 3 to 6. It is sandy loam, gravelly sandy loam, sandy clay loam, or gravelly sandy clay loam and is slightly acid to strongly acid.

The C horizon is grayish brown (10YR 5/2) or brown (10YR 5/3). It is neutral to moderately alkaline.

Owosso series

The Owosso series consists of deep, well drained, moderately permeable soils on moraines on the uplands. These soils formed in loamy outwash over loamy glacial till. Slope ranges from 0 to 2 percent.

Owosso soils are similar to Hillsdale, Metea, and Riddles soils and are commonly near Aubbeenaubbee soils. Hillsdale soils contain more sand throughout. Metea soils contain more sand in the upper part of the solum. Riddles soils have less than 20 inches of sandy loam. Aubbeenaubbee soils contain mottles with chroma of 2 just below the plow layer and are in lower positions.

Typical pedon of Owosso sandy loam, 0 to 2 percent slopes, in a cultivated field, 2,700 feet west and 200 feet north of southeast corner of Michigan Road Land sec. 17, T. 33 N., R. 2 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.
B1—9 to 17 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; friable; 4 percent gravel; slightly acid; clear wavy boundary.
B21t—17 to 24 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; thin patchy dark brown (7.5YR 3/2) clay films on peds; 5 percent gravel; slightly acid; clear wavy boundary.
IIB22t—24 to 34 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; firm; thin discontinuous dark brown (10YR 3/3) clay films on peds; 5 percent gravel; slightly acid; clear wavy boundary.
IIB23t—34 to 41 inches; yellowish brown (10YR 5/4) clay loam; weak coarse subangular blocky structure; firm; many black (10YR 2/1) decayed fragments of shale; 5 percent gravel; neutral; gradual wavy boundary.
IIB3—41 to 49 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; very dark brown (10YR 2/2) iron and manganese accumulations along old root channels; few light gray (10YR 7/2) calcium carbonate linings around pebbles; 5 percent gravel; neutral; gradual wavy boundary.
IIC—49 to 60 inches; brown (10YR 5/3) loam; massive; friable; 6 percent gravel; violent effervescence; moderately alkaline.

The solum is 36 to 50 inches thick.

The Ap horizon is dark brown (10YR 3/3), brown (10YR 4/3), or dark grayish brown (10YR 4/2) sandy loam or fine sandy loam.

The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam or fine sandy loam and is strongly acid to slightly acid. The IIBt horizon has the same colors as the B2t horizon. It is loam, clay loam, or sandy clay loam and is medium acid to neutral.

The IIC horizon is dark brown (10YR 4/3), yellowish brown (10YR 5/4), brown (10YR 5/3), and light yellowish brown (10YR 6/4). It is mildly alkaline or moderately alkaline.

Palms series

The Palms series consists of deep, very poorly drained soils in bogs and old lakebeds on till plains, outwash plains, and moraines. Permeability is moderately slow to moderately rapid in the organic material and moderate in the underlying loamy material. These soils formed in organic deposits over loamy material. Slope ranges from 0 to 2 percent.

Palms soils are similar to Adrian, Edwards, and Houghton soils. Adrian soils have 16 to 51 inches of muck over sand. Edwards soils have 16 to 51 inches of muck over marl. Houghton soils have more than 51 inches of muck.

Typical pedon of Palms muck, drained, in a cultivated field, 2,600 feet east and 300 feet south of the center of sec. 6, T. 32 N., R. 3 E.

Oap—0 to 9 inches; black (10YR 2/1) broken face sapric material, very dark brown (10YR 2/2) rubbed, black (N 2/0) dry; about 20 percent fiber, less than 5 percent rubbed; weak medium granular structure; friable; many fine roots; mostly herbaceous fiber; medium acid; abrupt smooth boundary.

Oa2—9 to 13 inches; black (10YR 2/1) broken face sapric material, very dark brown (10YR 2/2) rubbed; about 25 percent fiber, less than 10 percent rubbed; weak thick platy structure; friable; many fine roots; mostly herbaceous fiber; medium acid; clear smooth boundary.

Oa3—13 to 20 inches; very dark brown (10YR 2/2) broken face sapric material, very dark grayish brown (10YR 3/2) rubbed; about 50 percent fiber, less than 10 percent rubbed; weak thick platy structure; firm; mostly herbaceous fiber; medium acid; abrupt smooth boundary.

Oa4—20 to 26 inches; black (10YR 2/1) broken face sapric material, very dark brown (10YR 2/2) rubbed; about 30 percent fiber, less than 5 percent rubbed; massive; friable; mostly herbaceous fiber; 15 to 20 percent mineral content; slightly acid; abrupt wavy boundary.

IIC1g—26 to 36 inches; dark gray (10YR 4/1) sandy clay loam; few fine distinct yellowish red (5YR 4/6) mottles; massive; firm; neutral; gradual wavy boundary.

IIC2g—36 to 60 inches; olive gray (5Y 4/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; massive; firm; neutral.

The depth to the IIC horizon is 16 to 40 inches. The organic material is mainly herbaceous. The organic material ranges from medium acid to neutral.

The surface tier is black (10YR 2/1) or very dark brown (10YR 2/2) sapric material. The subsurface and bottom tiers have hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3 or are neutral and have value of 2 or 3.

The IIC horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5; and chroma of 1 or 2. It is loam, fine sandy loam, or sandy clay loam. It is mottled in most pedons and is slightly acid to mildly alkaline.

Pinhook series

The Pinhook series consists of deep, poorly drained soils on outwash plains. Permeability is moderately rapid in the solum and rapid in the substratum. These soils formed in shaly glacial outwash. Slope ranges from 0 to 2 percent.

Pinhook soils are similar to Brady soils and are near Gilford and Bronson soils. The Brady soils are predominantly brown and have mottles with chroma of 2 in the subsoil. Gilford soils have a mollic surface layer that is more than 10 inches thick and are in lower positions. Bronson soils are predominantly brown and have mottles with chroma of 2 in the subsoil and are in higher positions.

Typical pedon of Pinhook sandy loam, 0 to 2 percent slopes, 1,440 feet east and 450 feet north of the southwest corner of sec. 34, T. 35 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A2—9 to 14 inches; grayish brown (10YR 5/2) sandy loam; many coarse distinct dark brown (10YR 4/3) mottles; weak thin platy structure; friable; common fine roots; 2 percent gravel; slightly acid; clear wavy boundary.

B1tg—14 to 19 inches; light brownish gray (10YR 6/2) sandy loam; many coarse distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; few very fine roots; common grayish brown (10YR 5/2) clay bridges between sand grains; 2 percent gravel; medium acid; clear wavy boundary.

B21tg—19 to 24 inches; gray (10YR 5/1) sandy loam; many coarse distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few very fine roots; thin discontinuous dark gray (10YR 4/1) clay films on peds; 10 percent gravel; medium acid; gradual wavy boundary.

B22tg—24 to 35 inches; grayish brown (10YR 5/2) loamy sand; many coarse distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; thin discontinuous dark gray (10YR 4/1) clay bridges between sand grains; 12 percent gravel; medium acid; clear smooth boundary.

B3g—35 to 45 inches; gray (10YR 5/1) sand; common coarse distinct strong brown (7.5YR 5/6) mottles; massive; very friable; 10 percent gravel; medium acid; clear wavy boundary.

C1—45 to 58 inches; grayish brown (10YR 5/2) sand; common medium distinct yellowish brown (10YR 5/

6) mottles; massive; very friable; 12 percent gravel; neutral; gradual wavy boundary.
C2—58 to 62 inches; grayish brown (10YR 5/2) gravelly sand; single grain; loose; 18 percent gravel; slight effervescence; mildly alkaline.

The solum is 40 to 56 inches thick.

The A1 or Ap horizon is very dark gray (10YR 3/1), black (10YR 2/1), or very dark grayish brown (10YR 3/2) loam or sandy loam. The A2 horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2 and is loam or sandy loam.

The B2t horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 1 or 2. It is sandy loam or loamy sand and is mottled. It is very strongly acid to medium acid.

The C horizon has the same colors as the B2t horizon. The C horizon is loamy sand, sand, coarse sand, gravelly loamy sand, and gravelly sand. It is medium acid to mildly alkaline.

Plainfield series

The Plainfield series consists of deep, excessively drained, rapidly permeable soils on outwash plains. These soils formed in sandy sediment. Slope ranges from 0 to 18 percent.

Plainfield soils are similar to Chelsea and Tyner soils and are commonly near Brems soils. Chelsea soils have thin bands in the B horizon above a depth of 60 inches. Tyner soils have slightly more silt and clay in the subsoil. Brems soils have mottles in the lower part of the subsoil and are in lower positions.

Typical pedon of Plainfield sand, 0 to 2 percent slopes, in a cultivated field, 1,100 feet west and 1,400 feet north of the center of sec. 30, T. 34 N., R. 1 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.
B21—7 to 12 inches; strong brown (7.5YR 5/6) sand; single grain; loose; strongly acid; clear wavy boundary.
B22—12 to 21 inches; yellowish brown (10YR 5/6) sand; single grain; loose; medium acid; clear wavy boundary.
C1—21 to 40 inches; brownish yellow (10YR 6/6) sand; single grain; loose; medium acid; gradual wavy boundary.
C2—40 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; medium acid.

The solum is 20 to 32 inches thick.

The Ap horizon is dark brown (10YR 4/3), very dark grayish brown (10YR 3/2), or dark grayish brown (10YR 4/2). It is sand or loamy sand.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. It is sand or coarse sand. The upper part of the B horizon is very strongly acid or strongly acid, and the lower part is medium acid or strongly acid.

The C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 4 to 8. It is sand or coarse sand. It is medium acid or strongly acid.

Rensselaer series

The Rensselaer series consists of deep, very poorly drained, slowly permeable soils on lake plains and outwash plains. These soils formed in stratified loamy and sandy sediments. Slope ranges from 0 to 2 percent.

Rensselaer soils are similar to Brookston, Gilford, and Milford soils and are commonly near Crosier and Whitaker soils. Brookston soils are underlain by loam till. Gilford soils have less silt and clay in the subsoil. Milford soils contain more clay throughout the solum. Crosier and Whitaker soils do not have a mollic epipedon, have a predominately brown horizon in the subsoil, and are in higher positions.

Typical pedon of Rensselaer loam, in a cultivated field, 1,150 feet east and 380 feet north of the southwest corner of sec. 9, T. 33 N., R. 4 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.
A12—11 to 15 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; common fine distinct dark brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable; neutral; clear wavy boundary.
B21tg—15 to 26 inches; dark gray (10YR 4/1) clay loam; few fine distinct yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; thin discontinuous very dark gray (10YR 3/1) clay films on peds; slightly acid; clear wavy boundary.
B22tg—26 to 38 inches; gray (10YR 6/1) clay loam; common medium distinct yellowish red (5YR 5/8) and common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; thin discontinuous dark gray (10YR 4/1) clay films on peds; neutral; clear wavy boundary.
B23tg—38 to 42 inches; gray (10YR 5/1) loam; common medium distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; thin patchy dark gray (10YR 4/1) clay films on peds; slight effervescence; mildly alkaline; clear wavy boundary.
Cg—42 to 60 inches; gray (10YR 6/1) stratified fine sand and silt loam; few medium distinct brownish yellow (10YR 6/8) mottles; massive; friable; 10 percent fine gravel; strong effervescence; moderately alkaline.

The solum is 30 to 50 inches thick. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2; or it is black (N 2/0) and is mottled in the lower part. It is loam, silt loam, or clay loam.

The B2g horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 to 6; and chroma of 1 or 2 and is mottled. It is clay loam, sandy clay loam, or loam. Strata of sand or loamy sand are evident in the lower part of the B2tg horizon.

The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, chroma of 1 to 6 and is mottled. It is stratified clay loam, silt loam, sand, fine sand, loam, very fine sandy loam, or loamy sand.

Riddles series

The Riddles series consists of deep, well drained, moderately permeable soils on moraines on the uplands. These soils formed in loamy glacial till. Slope ranges from 0 to 18 percent.

Riddles soils are similar to Martinsville and Wawasee soils and are near Aubbeenaubbee, Crosier, and Metea soils. Martinsville soils contain stratified material in the lower part of the solum and in the substratum. Wawasee soils have a thinner solum. Aubbeenaubbee and Crosier soils have mottles with chroma of 2 or less in the upper part of the B horizon and are in lower positions. Metea soils contain more sand in the upper part of the solum.

Typical pedon of Riddles sandy loam, 2 to 6 percent slopes, in a cultivated field, 200 feet east and 300 feet north of the southwest corner of sec. 9, T. 32 N., R. 2 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; friable; 8 percent gravel; neutral; abrupt smooth boundary.

B1—9 to 13 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; 6 percent gravel; neutral; clear smooth boundary.

B21t—13 to 24 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; 5 percent gravel; thin discontinuous dark brown (7.5YR 4/4) clay films on peds; slightly acid; gradual wavy boundary.

B22t—24 to 48 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; 3 percent gravel; thin discontinuous dark brown (7.5YR 4/4) clay films on peds; medium acid; clear wavy boundary.

C—48 to 60 inches; brown (10YR 5/3) loam; massive; firm; 8 percent gravel; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 5/3), or dark brown (10YR 4/3). Where present, the A2 horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4). The A horizon is sandy loam or loam.

The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sandy clay loam, loam or clay loam. The upper part of the B horizon is strongly acid to neutral and the lower part is medium acid to neutral.

The C horizon is brown (10YR 5/3) or light yellowish brown (10YR 6/4) loam or sandy loam. It is neutral to moderately alkaline.

Shipshe series

The Shipshe series consists of deep, well drained soils on outwash plains and terraces. Permeability is moderately rapid in the solum and very rapid in the substratum. These soils formed in outwash over stratified calcareous sand and gravel. Slope ranges from 0 to 2 percent.

Shipshe soils are similar to Elston soils and are commonly near Fox and Oshtemo soils. Elston soils have a thicker solum. Fox soils have a lighter colored surface layer. Oshtemo soils do not have a mollic epipedon and have more sand in the subsoil.

Typical pedon of Shipshe sandy loam, 0 to 2 percent slopes, in a cultivated field, 1,620 feet east and 75 feet north of the southwest corner of sec. 24, T. 33 N., R. 2 E.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) sandy loam, dark brown (10YR 4/3) dry; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A12—11 to 15 inches; dark brown (7.5YR 3/2) sandy loam; weak medium granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

B21t—15 to 26 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (7.5YR 3/2) clay films on peds; 40 percent gravel; medium acid; clear wavy boundary.

IIC1—26 to 31 inches; dark brown (7.5YR 4/4) very gravelly sand; massive; very friable; thin discontinuous dark brown (7.5YR 3/2) bridges between sand grains; 35 percent gravel; slight effervescence; mildly alkaline; gradual irregular boundary.

IIC2—31 to 36 inches; brown (10YR 5/3) very gravelly coarse sand; single grain; loose; 45 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC3—36 to 60 inches; light yellowish brown (10YR 6/4) stratified very gravelly sand and coarse sand; single grain; loose; 37 percent gravel; strong effervescence; moderately alkaline.

The solum is 24 to 35 inches thick.

The Ap horizon has hue of 10YR, value of 2, and chroma of 1 or 2. The A horizon is either loam or sandy loam.

The B2t horizon has hue of 5YR, 7.5YR, or 10YR; value of 3 or 4; and chroma of 3 or 4. It is loamy sand, sandy loam, loam, or sandy clay loam and the gravelly analogs of these textures. It is slightly acid or medium acid.

The IIC horizon is stratified coarse sand and gravelly sand and is mildly alkaline or moderately alkaline.

Stonelick series

The Stonelick series consists of deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in stratified alluvial material. Slope ranges from 0 to 2 percent.

Stonelick soils are near Fluvaquents. Fluvaquents have more gray in the upper 20 inches and are in lower positions on the flood plain.

Typical pedon of Stonelick sandy loam, in a cultivated field, 1,500 feet east and 1,040 feet south of the northwest corner of sec. 33, T. 33 N., R. 1 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.
C1—9 to 16 inches; dark brown (7.5YR 4/4) sandy loam; weak medium platy structure; friable; few fine roots; slightly acid; clear wavy boundary.
C2—16 to 24 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; neutral; clear wavy boundary.
C3—24 to 32 inches; dark brown (10YR 4/3) sandy loam; common medium distinct light brownish gray (2.5Y 6/2) mottles; weak medium subangular blocky structure; friable; many very dark brown (10YR 2/2) iron and manganese oxide accumulations; neutral; clear wavy boundary.
C4—32 to 46 inches; grayish brown (10YR 5/2) loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; many very dark brown (10YR 2/2) iron and manganese oxide accumulations; neutral; clear wavy boundary.
C5—46 to 60 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) stratified silt loam and sandy loam; massive; friable; neutral.

The Ap horizon is dark grayish brown (10YR 4/3), dark brown (10YR 3/3), or yellowish brown (10YR 5/4). It is sandy loam, fine sandy loam, or loamy fine sand. The A1 horizon, where present, has hue of 10YR, value of 3 or 4, and chroma of 1 or 2.

The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The C horizon is stratified sandy loam, fine sandy loam, silt loam, and loam.

Troxel series

The Troxel series consists of deep, well drained, moderately permeable soils in depressions or concave positions on outwash plains. They formed in silty material and loamy glacial drift over outwash. Slope ranges from 0 to 2 percent. These soils are taxadjuncts to the Troxel series because they have too much sand in the solum. This difference does not alter the usefulness or behavior of these soils.

Troxel soils are commonly near Elston and Linkville soils. Elston soils have a mollic epipedon less than 24 inches thick, contain less clay in the solum, and are in higher positions. Linkville soils have a mollic epipedon less than 24 inches thick and are in higher positions.

Typical pedon of Troxel silt loam, in a cultivated field, 500 feet west and 300 feet north of the southeast corner of sec. 11, T. 33 N., R. 2 E.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; neutral; abrupt smooth boundary.
A12—10 to 23 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; neutral; clear smooth boundary.
A13—23 to 27 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; slightly acid; gradual wavy boundary.
B21—27 to 42 inches; dark brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; slightly acid; gradual wavy boundary.
IIB22t—42 to 60 inches; dark brown (10YR 3/2) clay films on peds; firm; 3 percent gravel; medium acid; gradual wavy boundary.
IIB3—60 to 75 inches; dark brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; 5 percent gravel; slightly acid; gradual wavy boundary.
IIIC—75 to 80 inches; dark brown (10YR 4/4) sand; single grain; loose; 10 percent gravel; neutral.

The solum is 60 to 85 inches thick. The mollic epipedon is 24 to 40 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3.

The B2 horizon has hue of 10YR, value of 3 to 5, and chroma of 3 to 6. It is loam, silt loam, clay loam, sandy clay loam, or the gravelly analogs of these textures. It is medium acid to neutral.

The C horizon is sandy loam, loamy sand, sand, or the gravelly analogs of these textures. It is slightly acid to mildly alkaline.

Tyner series

The Tyner series consists of deep, well drained, rapidly permeable soils on outwash plains on the

uplands. These soils formed in strongly acid, sandy material from glacial drift that has been reworked by wind. Slope ranges from 0 to 12 percent.

Tyner soils are similar to Chelsea and Plainfield soils and are near Brems soils. Chelsea soils have sand throughout the solum and loamy sand bands below a depth of about 30 inches. Plainfield soils contain less clay throughout the solum. Brems soils have mottles in the lower part of the solum and are in lower positions.

Typical pedon of Tyner loamy sand, 0 to 2 percent slopes, in a cultivated field, 1,550 feet north and 700 feet east of the southwest corner of sec. 19, T. 35 N., R. 1 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) loamy sand, yellowish brown (10YR 5/4) dry; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.
B1—7 to 12 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium granular structure; very friable; strongly acid; clear smooth boundary.
B21—12 to 20 inches; yellowish brown (10YR 5/4) loamy sand; weak medium granular structure; very friable; 2 percent gravel; medium acid; clear wavy boundary.
B22—20 to 36 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium granular structure; very friable; 12 percent gravel; medium acid; gradual wavy boundary.
B3—36 to 42 inches; yellowish brown (10YR 5/6) fine sand; single grain; loose; 2 percent gravel; medium acid; gradual wavy boundary.
C—42 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; medium acid.

The solum is 40 to 50 inches thick.

The Ap horizon is dark brown (10YR 3/3, 10YR 4/3) and very dark grayish brown (10YR 3/2) loamy sand.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 5, and chroma of 3 to 6. It is very strongly acid to medium acid. The C horizon is yellowish brown (10YR 5/4) or light yellowish brown (10YR 6/4) fine sand or sand. It is medium acid or slightly acid.

Wallkill series

The Wallkill series consists of deep, very poorly drained soils in upland depressions. Permeability is moderate in the mineral material and moderately rapid in the organic material. These soils formed in alluvium over organic material. Slope ranges from 0 to 2 percent.

Wallkill soils are commonly near Houghton and Palms soils. The Houghton and Palms soils are organic.

Typical pedon of Wallkill loam, in a cultivated field, 1,550 feet south and 700 feet east of the northwest corner of sec. 34, T. 32 N., R. 3 E.

Ap—0 to 9 inches; dark gray (10YR 4/1) loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; slightly acid; abrupt smooth boundary.
Bg—9 to 16 inches; dark gray (10YR 4/1) silt loam; weak medium subangular blocky structure; firm; common medium distinct dark reddish brown (5Y 3/4) streaks inside old root channels; slightly acid; clear smooth boundary.
Cg—16 to 20 inches; dark gray (10YR 4/1) and black (10YR 2/1) mucky silt loam; massive; friable; slightly acid; clear smooth boundary.
IIOa1—20 to 32 inches; black (N 2/0) sapric material, very dark brown (10YR 2/2) rubbed and pressed; less than 10 percent fiber, less than 5 percent rubbed and pressed; massive; friable; medium acid; gradual wavy boundary.
IIOa2—32 to 46 inches; black (5YR 2/1) sapric material, dark reddish brown (5YR 2/2) rubbed and pressed; less than 20 percent fiber, less than 5 percent rubbed and pressed; massive; friable; slightly acid; gradual wavy boundary.
IIOa3—46 to 60 inches; black (5YR 2/1) sapric material, dark reddish brown (5YR 2/2) rubbed and pressed; less than 10 percent fiber, less than 5 percent rubbed and pressed; massive; friable; thin lenses of gray (10YR 6/1) silt loam; slightly acid.

The mineral material is 16 to 30 inches thick over the organic material.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 or 2. It is silt loam or loam.

The Bg horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 to 5; and chroma of 1 or 2. It is silt loam or loam and is medium acid to neutral.

The Cg horizon has the same color and texture as the Bg horizon, but the material is mucky in places. It is medium acid to neutral.

The IIOa horizon has hue of 5YR to 2.5Y, value of 2 or 3, and chroma of 1 or 2; or it is neutral and has value of 2 or 3. It is medium acid to mildly alkaline.

Washtenaw series

The Washtenaw series consists of deep, very poorly drained, slowly permeable soils in nearly level or depressional areas on moraines, till plains, and outwash plains. These soils formed in alluvium over glacial drift. Slope ranges from 0 to 2 percent.

Washtenaw soils are similar to Wallkill soils and are commonly near Fox, Metea, and Riddles soils. Wallkill soils have a buried organic layer. Fox, Metea, and Riddles soils do not have gray colors in the subsoil and are on sloping uplands surrounding Washtenaw soils.

Typical pedon of Washtenaw silt loam, in a cultivated field, 1,700 feet south and 2,500 feet east of the northwest corner of sec. 33, T. 32 N., R. 1 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak medium

granular structure; friable; slightly acid; abrupt smooth boundary.
C—10 to 20 inches; grayish brown (10YR 5/2) loam; few fine faint yellowish brown (10YR 5/4) mottles; weak medium granular structure; friable; slightly acid; clear smooth boundary.
AC—20 to 23 inches; dark grayish brown (10YR 4/2) and very dark gray (10YR 3/2) loam; weak fine granular structure; friable; slightly acid; clear wavy boundary.
IIA1b—23 to 30 inches; very dark gray (10YR 3/1) silt loam; moderate medium subangular blocky structure; firm; neutral; clear wavy boundary.
IIB21tgb—30 to 36 inches; dark grayish brown (10YR 4/2) clay loam; moderate medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; thin discontinuous very dark gray (10YR 3/1) clay films on peds; dark brown organic coatings on vertical faces of peds; neutral; gradual wavy boundary.
IIB22tgb—36 to 58 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse angular blocky structure; firm; thin discontinuous dark gray (10YR 4/1) clay films on peds; few dark reddish brown (5YR 3/4) iron and manganese oxide accumulations; neutral; gradual wavy boundary.
IIC—58 to 66 inches; gray (10YR 5/1) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; slight effervescence; mildly alkaline.

The overwash is 20 to 40 inches thick. The buried soil is 24 to 40 inches thick. The solum is medium acid to neutral. The lower part is slightly acid to mildly alkaline.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is loam or silt loam.

The C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 or less. The C horizon has the same texture as the Ap horizon and is mottled.

The IIA1b horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or black (10YR 2/1). It is silt loam, loam, silty clay loam, or clay loam.

The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 to 6; and chroma of 1 or 2. It is silty clay loam or clay loam and is mottled.

Wawasee series

The Wawasee series consists of deep, well drained, moderately permeable soils on moraines on the uplands. These soils formed in loamy glacial till. Slope ranges from 2 to 18 percent.

Wawasee soils are similar to Riddles soils and are near Aubbeenaubbee and Crosier soils. Riddles soils have a thicker solum. Aubbeenaubbee and Crosier soils contain mottles with chroma of 2 just below the plow layer and are in lower positions.

Typical pedon of Wawasee sandy loam, 2 to 6 percent slopes, in a cultivated field, 1,400 feet north and 1,500 feet west of the southeast corner of sec. 35, T. 32 N., R. 1 E.

Ap—0 to 10 inches; brown (10YR 5/3) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few fine roots; 5 percent gravel; neutral; abrupt smooth boundary.
B21t—10 to 21 inches; strong brown (7.5YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on peds; 5 percent gravel; medium acid; clear wavy boundary.
B22t—21 to 27 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on peds; common black (10YR 2/1) iron and manganese oxide accumulations; 5 percent gravel; strongly acid; gradual wavy boundary.
B23t—27 to 35 inches; dark brown (7.5YR 4/4) loam; weak coarse subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (10YR 4/3) clay films on peds; few black (10YR 2/1) iron and manganese oxide accumulations; 5 percent gravel; medium acid; gradual wavy boundary.
B3t—35 to 39 inches; dark yellowish brown (10YR 4/4) and brown (10YR 5/3) loam; weak coarse subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (10YR 4/3) clay films on peds; 5 percent gravel; slight effervescence; mildly alkaline; diffuse irregular boundary.
C—39 to 60 inches; brown (10YR 5/3) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

The solum is 28 to 40 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is sandy loam, fine sandy loam, or loam. The A1 horizon, where present, is dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2).

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy clay loam and loam. The B2t horizon is strongly acid or slightly acid.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 5. It is loam or sandy loam. It is moderately alkaline or mildly alkaline.

Whitaker series

The Whitaker series consists of deep, somewhat poorly drained, moderately permeable soils on terraces and outwash plains. These soils formed in loamy deposits over stratified loamy and sandy sediments. Slope ranges from 0 to 2 percent.

Whitaker soils are similar to Crosier soils and are commonly near Martinsville and Rensselaer soils. Crosier

soils do not have stratification in the substratum. Martinsville soils have a yellowish brown subsoil and are in higher positions. Rensselaer soils have gray horizons in the subsoil and a mollic epipedon and are in swales and undefined drainageways.

Typical pedon of Whitaker loam, in a cultivated field, 2,100 feet west and 1,000 feet north of the southeast corner of sec. 11, T. 34 N., R. 3 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, light gray (10YR 6/2) dry; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A2—9 to 17 inches; brown (10YR 5/3) loam; common medium distinct yellowish brown (10YR 5/8) and common medium faint light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; common fine roots; slightly acid; clear wavy boundary.

B21tg—17 to 27 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; 2 percent gravel; few fine roots; thin discontinuous dark gray (10YR 5/1) clay films on peds; common fine black (10YR 2/1) iron and manganese oxide stains; strongly acid; gradual wavy boundary.

B22t—27 to 39 inches; grayish brown (10YR 5/2) sandy clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; 2 percent gravel; thin discontinuous gray (10YR 5/1) clay films on peds; common fine black (10YR 2/1) iron and manganese oxide stains; medium acid; clear wavy boundary.

B3—39 to 48 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; friable; slightly acid; clear wavy boundary.

C—48 to 60 inches; brown (10YR 5/3) stratified loamy sand, loam, and silt loam; common fine faint grayish brown (10YR 5/2) mottles; massive; strong effervescence; moderately alkaline.

The solum is 36 to 55 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. The A2 horizon is grayish brown (10YR 5/2), brown (10YR 5/3), light brownish gray (10YR 6/2), and pale brown (10YR 6/3). The A horizon is sandy loam, fine sandy loam, silt loam, or loam.

The B2t horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 to 4 and is mottled. It is clay loam, loam, sandy clay loam, or sandy loam. The upper part is strongly acid or medium acid and the lower part is medium acid to neutral.

The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 4 and is mottled. It is stratified. Textures include silt loam, clay loam, sandy loam, loam, sand, fine sand, loamy sand, or sandy clay loam. It is neutral to moderately alkaline.

formation of the soils

In this section the major factors and processes of soil formation and their importance in the formation of the soils in Marshall County are discussed.

factors of soil formation

Soil is produced by soil-forming processes acting on material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

parent material

Parent material is the unconsolidated mass in which a soil forms. Parent material determines the limits of the chemical and mineralogical composition of the soil. The parent materials of the soils of Marshall County were deposited by the glaciers that covered the county about 10,000 to 12,000 years ago or by melt water from the glaciers. After being first deposited, some of the material was reworked and redeposited by water and wind.

Although the parent materials in Marshall County are of common glacial origin, their properties vary greatly, sometimes within small areas. The properties of the parent materials, and therefore of the soils, depend on how the materials were deposited. The main parent materials in Marshall County were deposited as glacial till, outwash, lacustrine material, alluvium, and organic material.

Glacial till was laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes mixed together. The glacial till in Marshall County is firm, calcareous loam. Riddles soils, for example, formed in glacial till. These soils typically are moderately coarse textured and have well developed structure.

Outwash was deposited by water running from melting glaciers. The size of the particles in outwash material varies according to the speed of the stream that carried them. When a stream of water slows down, the coarser particles settle out. Finer particles, such as very fine sand, silt, and clay, can be carried by more slowly moving water. Outwash deposits generally consist of layers of particles of similar size, such as sand, gravel, and other coarse particles. Brady soils, for example, formed in outwash.

Lacustrine material settled out of still, or ponded, glacial melt water. Because the coarser fragments drop out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remain to settle out in still water. Lacustrine deposits are silty or clayey. The Milford soils are an example of soils that formed in lacustrine material.

Alluvium was deposited by flood waters of present streams in recent time. The texture of the alluvium depends on the speed of the water from which it was deposited. The alluvium deposited along a swift stream such as Yellow River is coarser textured than that deposited along a slow, sluggish stream such as branches of Pine Creek. Stonelick soils and Fluvaquents formed in alluvium.

Organic deposits consist of partially decomposed plant remains. After the glaciers melted, water was left standing in depressions in outwash, lake, and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains fell to the bottom. Because these areas are so wet, the plant remains did not decompose but remained around the edge of the lake. Later tamarack and other water-tolerant trees grew in the areas. As these trees died, their residues became part of the organic accumulation. The lakes eventually filled with organic material and developed into areas of muck. In some of these areas, the plant remains

subsequently decomposed. In other areas, the material has changed little since deposition. Houghton soils are an example of soils that formed in organic material.

plant and animal life

Higher plants, micro-organisms such as bacteria and fungi, earthworms, and other forms of life influence the development of soil. The chief contribution of plants and animals is the organic matter and nitrogen that they add to the soil. The kind of organic material in the soil depends mainly on the kinds of plants that grow on the soil. The remains of these plants accumulate in the surface layer, decay, and become organic matter. Roots provide channels for movement of water through the soil and also add organic matter as they decay. Bacteria and other micro-organisms help to break down the organic matter so that it can be used by growing plants.

The vegetation in Marshall County was mainly mixed forests. Differences in natural drainage and minor differences in parent material affected the composition of the forest.

In general the well drained soils, such as Oshtemo and Riddles soils, were covered mainly by oak, beech, ash, hickory, walnut, sugar maple, and soft maple. Plainfield soils were covered by white pine and scrub oak. The well drained Linkville and Elston soils were covered mainly by grasses such as big bluestem, little bluestem, and indiangrass and groves of bur oak. Gilford soils developed under wet conditions and contain much organic matter. The wet soils were covered by soft maple, ash, swamp white oak, and tamarack; or if they were more marshy, they were covered by marsh plants including sedges, rushes, and coarse grasses. A few wet soils also had sphagnum and other mosses which contributed substantially to the organic accumulation. Adrian and Houghton soils developed in high water and are organic.

The soils that developed under dominantly forest vegetation generally have less total accumulated organic matter than soils in the county that developed under dominantly grass.

climate

Climate is important in the formation of soil. It determines the kinds of plants and animals on and in the soil. It determines the amount of water available for weathering minerals and transporting soil material. Through its influence on temperature in the soil, climate determines the rate of chemical reactions in the soil. These influences are important, but they are fairly uniform over larger areas than a county.

The climate in Marshall County is cool and humid. This is presumably similar to that which existed as the soils formed. The soils in Marshall County differ from soils that formed in a dry, warm climate or from those that formed in a hot, moist climate.

Climate is uniform throughout Marshall County, but its effect is modified locally by Lake Michigan. Therefore the differences in the soils of Marshall County are to only a minor extent the results of the differences in climate. More detailed information on the climate of this county is given in the section "General nature of the county."

relief

Relief, or topography, has a marked influence on soils through its influence on natural drainage, erosion, plant cover, and soil temperature. In Marshall County, slope ranges from 0 to 18 percent. Natural soil drainage ranges from well drained on the ridgetops to very poorly drained in the depressions.

Relief influences runoff and drainage; drainage in turn, through its effect on aeration of the soil, affects the soil's color. Runoff of water is greatest on the steeper slopes, whereas in low areas water is temporarily ponded. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are oxidized and brightly colored. In poorly aerated soils, these compounds are unoxidized and the soil is dull gray and mottled. Oshtemo soils are an example of well drained, well aerated soils, and Brookston soils are very poorly drained and poorly aerated.

time

Time, usually a long time, is required for distinct horizons to form in parent material. The differences in length of time that the parent materials have been in place are commonly reflected in the degree of development of the soil profile. The soils in Marshall County range from young to mature. The glacial deposits, in which many of the mature soils formed, have been in place long enough for distinct horizons to develop; Riddles soils are an example. However, some soils in recent alluvial sediments have not been in place long enough to form distinct horizons. Fluvaquents are young soils that formed in alluvium.

Some soils develop rapidly and others develop slowly because of differences in their positions on the landscape. Milford soils were submerged under glacial lake water and protected from leaching for a long time. In contrast, Tyner soils were above water and subject to leaching.

Differences in the length of time of leaching also can be caused by differences in natural drainage. The upper part of the Riddles and Crosier soils at one time had about the same amount of lime as their C horizon has today. The difference in length of time that leaching has taken place is reflected by the difference in depth to which carbonates have been moved. Riddles soils are leached of carbonates to a depth of 50 to 60 inches, but Crosier soils have carbonates still at a depth of 24 to 35 inches.

processes of soil formation

Several processes have been involved in the formation of the soils of this county. These processes are the accumulation of organic matter; the solution, transfer, and removal of calcium carbonates and bases; the liberation and translocation of silicate clay minerals; and the reduction and transfer of iron. In most soils, more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all of the soils in this county. Organic matter content is low in some soils and high in others. Generally, the soils that have the most organic matter, such as Gilford and Rensselaer soils, have a thick black surface horizon.

Carbonates and bases have been leached from the upper part of nearly all soils in this county. Most of the carbonates and some of the bases have been leached from the A and B horizons of well drained soils. Even the wettest soils have been leached some, as indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because of the high water table or because water moves slowly through such soils.

Clay accumulates in pores and other voids and forms films on the sufaces along which water moves. Wawasee soils are examples of soils in which translocated silicate clays have accumulated as clay films in the B2t horizon.

Leaching of bases and translocation of clays are among the more important processes in horizon differentiation in the soils of Marshall County. Leaching is generally believed to precede translocation of clay minerals.

The reduction and transfer of iron, called gleying, has taken place in all of the very poorly drained and somewhat poorly drained soils in this county. This process has been significant in horizon differentiation in naturally wet soils. The gray color of the subsoil indicates the reduction of iron oxides. Reduction is commonly accompanied by some transfer of iron downward, either to lower horizons or completely out of the profile. Mottles indicate segregation of iron.

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glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compact layers to depths below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Controlled drainage system. A subsurface system designed to be used for drainage in wet periods and for irrigation in dry periods.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.
Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.
Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.
Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainage, subsurface. Removal of excess ground water through drain lines buried in the soil. The drains collect the water and convey it to a gravity or pump outlet.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered

but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron,

and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002

millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-74 at Plymouth, Ind.]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January	32.9	15.8	24.4	59	-16	12	1.89	1.01	2.59	5	8.8
February	37.1	19.2	28.2	62	-11	14	1.70	.90	2.34	5	8.4
March	47.1	27.3	37.2	80	2	98	2.51	1.78	3.17	7	5.4
April	62.3	38.4	50.4	85	18	318	4.12	2.68	5.43	9	1.3
May	73.5	48.0	60.8	92	27	645	3.43	2.07	4.65	7	.0
June	83.4	57.2	70.3	98	39	909	4.17	2.80	5.41	7	.0
July	86.1	60.9	73.5	98	44	1,039	4.37	2.70	5.86	7	.0
August	84.6	58.8	71.7	96	41	983	3.14	1.75	4.26	5	.0
September	78.4	51.8	65.1	95	31	753	3.23	1.49	4.64	6	.0
October	66.4	41.7	54.0	87	23	438	3.22	1.22	4.82	6	.2
November	49.5	31.1	40.3	74	9	96	2.53	1.66	3.30	6	3.5
December	37.1	21.7	29.4	64	-10	29	2.47	1.01	3.65	6	8.7
Yearly	61.5	39.3	50.4	99*	-17*	5,334	36.78	31.14	42.17	76	36.3

* Extreme temperatures.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-74 at Plymouth, Ind.]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 19	May 12	May 20
2 years in 10 later than--	April 15	May 5	May 15
5 years in 10 later than--	April 9	April 23	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	October 13	October 6	September 21
2 years in 10 earlier than--	October 19	October 11	September 26
5 years in 10 earlier than--	October 31	October 20	October 5

TABLE 3.--GROWING SEASON LENGTH

[Recorded in the period 1951-74 at Plymouth, Ind.]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	185	156	139
8 years in 10	192	164	144
5 years in 10	204	180	152
2 years in 10	216	195	160
1 year in 10	223	203	164

TABLE 4.--POTENTIALS AND LIMITATIONS OF GENERAL SOIL MAP UNITS FOR SPECIFIED USES

Map Unit	Percentage of county	Cultivated crops	Woodland	Urban uses	Intensive recreation areas
1. Oshtemo-Owosso-Fox------	15	Fair: slopes, droughty.	Good--------	Fair: slopes, poor filter.	Fair: slopes, small stones.
2. Plainfield-Tyner-Chelsea	11	Poor: slopes, droughty.	Fair: slopes, droughty.	Fair: poor filter.	Fair: slopes, sandy.
3. Rensselaer-Whitaker-----	12	Good-------	Fair: wetness, ponding.	Poor: wetness, ponding.	Poor: wetness, ponding.
4. Crosier-Brookston-------	16	Good-------	Fair: wetness, ponding.	Poor: wetness, ponding.	Poor: wetness, ponding.
5. Riddles-Metea-Wawasee---	36	Fair: slopes.	Good--------	Fair: slopes, shrink-swell.	Fair: slopes, small stones.
6. Martinsville-Riddles----	4	Fair: slopes.	Good--------	Fair: slopes, shrink-swell.	Fair: slopes.
7. Houghton-Adrian-Palms---	6	Fair: wetness.	Poor: wetness, ponding.	Poor: wetness, ponding, excess humus.	Poor: wetness, ponding, excess humus.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Adrian muck, drained	3,898	1.4
AuA	Aubbeenaubbee sandy loam, 0 to 2 percent slopes	5,988	2.1
Bd	Brady sandy loam	5,898	2.1
BeA	Brems sand, 0 to 2 percent slopes	4,925	1.7
BoA	Bronson loamy sand, 0 to 2 percent slopes	3,728	1.3
Br	Brookston loam	21,257	7.5
ChB	Chelsea fine sand, 2 to 6 percent slopes	3,738	1.3
ChC	Chelsea fine sand, 6 to 12 percent slopes	2,416	0.8
CtA	Crosier loam, 0 to 2 percent slopes	28,250	9.9
Ed	Edwards muck, drained	1,794	0.6
EsA	Elston sandy loam, 0 to 2 percent slopes	859	0.3
Fc	Fluvaquents, loamy	4,102	1.4
FsA	Fox sandy loam, 0 to 2 percent slopes	1,794	0.6
FsB	Fox sandy loam, 2 to 6 percent slopes	1,770	0.6
FsC2	Fox sandy loam, 6 to 12 percent slopes, eroded	553	0.2
Gf	Gilford sandy loam	8,998	3.1
HdB	Hillsdale sandy loam, 2 to 6 percent slopes	1,390	0.5
Ho	Houghton muck, drained	11,469	4.0
Hp	Houghton muck, ponded	3,481	1.2
LnA	Linkville sandy loam, 0 to 2 percent slopes	2,114	0.7
LnB	Linkville sandy loam, 2 to 6 percent slopes	645	0.2
MeA	Martinsville loam, 0 to 2 percent slopes	1,488	0.5
MeB	Martinsville loam, 2 to 6 percent slopes	2,469	0.9
MeC2	Martinsville loam, 6 to 12 percent slopes, eroded	925	0.3
MgB	Metea loamy fine sand, 2 to 6 percent slopes	9,171	3.2
MgC	Metea loamy fine sand, 6 to 12 percent slopes	2,902	1.0
Mn	Milford silty clay loam	2,082	0.7
Ne	Newton loamy fine sand	1,629	0.6
OsA	Oshtemo loamy sand, 0 to 2 percent slopes	5,716	2.0
OsB	Oshtemo loamy sand, 2 to 6 percent slopes	8,310	2.9
OsC	Oshtemo loamy sand, 6 to 12 percent slopes	3,105	1.1
OsD	Oshtemo loamy sand, 12 to 18 percent slopes	884	0.3
OwA	Owosso sandy loam, 0 to 2 percent slopes	4,503	1.6
Pa	Palms muck, drained	2,649	0.9
PdA	Pinhook sandy loam, 0 to 2 percent slopes	2,064	0.7
PsA	Plainfield sand, 0 to 2 percent slopes	1,874	0.7
PsC	Plainfield sand, 3 to 10 percent slopes	4,004	1.4
PsD	Plainfield sand, 12 to 18 percent slopes	368	0.1
Re	Rensselaer loam	32,300	11.3
RsA	Riddles sandy loam, 0 to 2 percent slopes	9,000	3.1
RsB	Riddles sandy loam, 2 to 6 percent slopes	29,128	10.2
RsC2	Riddles sandy loam, 6 to 12 percent slopes, eroded	6,986	2.4
RsD	Riddles sandy loam, 12 to 18 percent slopes	942	0.3
SpA	Shipshe sandy loam, 0 to 2 percent slopes	261	0.1
St	Stonelick sandy loam	599	0.2
Tx	Troxel silt loam	756	0.3
TyA	Tyner loamy sand, 0 to 2 percent slopes	1,567	0.5
TyB	Tyner loamy sand, 2 to 6 percent slopes	2,138	0.7
TyC	Tyner loamy sand, 6 to 12 percent slopes	891	0.3
Ua	Udorthents, loamy	612	0.2
Wa	Wallkill loam	864	0.3
Wh	Washtenaw silt loam	1,849	0.6
WkB	Wawasee sandy loam, 2 to 6 percent slopes	5,143	1.8
WkC2	Wawasee sandy loam, 6 to 12 percent slopes, eroded	3,383	1.2
WmD3	Wawasee sandy clay loam, 12 to 18 percent slopes, severely eroded	1,238	0.4
Wt	Whitaker loam	11,230	3.9
	Water	5,263	1.8
	Total	287,360	100.0

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Ad---- Adrian	90	23	---	---	---
AuA---- Aubbeenaubbee	110	38	50	3.6	7.2
Bd---- Brady	80	30	35	3.0	6.2
BeA---- Brems	70	24	32	2.3	4.6
BoA---- Bronson	75	28	35	3.0	6.0
Br---- Brookston	130	51	50	4.8	9.6
ChB---- Chelsea	55	21	---	2.0	4.0
ChC---- Chelsea	45	20	---	1.8	3.6
CtA---- Crosier	115	42	54	4.0	8.0
Ed---- Edwards	90	34	---	---	---
EsA---- Elston	90	32	40	3.0	6.0
FsA---- Fox	85	32	45	4.5	8.0
FsB---- Fox	85	30	42	4.5	8.0
FsC2---- Fox	70	28	38	4.0	7.8
Gf---- Gilford	120	42	54	4.0	8.0
HdB---- Hillsdale	85	35	40	4.0	8.0
Ho---- Houghton	115	34	---	---	---
LnA---- Linkville	130	46	52	4.3	8.6
LnB---- Linkville	130	46	52	4.3	8.6
MeA---- Martinsville	110	42	48	4.0	8.0
MeB---- Martinsville	110	42	48	4.0	8.0

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
MeC2--- Martinsville	90	37	42	3.4	6.8
MgB--- Metea	80	30	42	2.8	5.6
MgC--- Metea	70	26	38	2.5	5.0
Mn--- Milford	115	48	50	5.2	5.4
Ne--- Newton	85	35	45	3.3	6.6
OsA, OsB--- Oshtemo	85	28	30	2.1	4.2
OsC--- Oshtemo	70	24	28	2.1	4.2
OsD--- Oshtemo	60	21	24	1.8	3.6
OwA--- Owosso	90	32	40	4.0	8.0
Pa--- Palms	105	42	---	---	---
PdA--- Pinhook	95	40	46	3.8	7.6
PsA--- Plainfield	60	20	22	2.0	4.0
Re--- Rensselaer	130	53	50	5.0	10.0
RsA--- Riddles	120	42	48	4.0	8.0
RsB--- Riddles	115	40	46	3.8	7.6
RsC2--- Riddles	105	37	42	3.4	6.8
RsD--- Riddles	90	32	36	3.0	6.0
SpA--- Shipshe	75	32	40	3.0	6.0
St--- Stonelick	80	28	---	3.5	7.0
Tx--- Troxel	130	45	---	4.3	8.6
TyA, TyB--- Tyner	70	24	32	2.3	4.6
TyC--- Tyner	55	21	27	2.0	4.0

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Wa---------- Wallkill	90	40	---	3.5	7.0
Wh---------- Washtenaw	120	46	52	4.3	8.6
WkB---------- Wawasee	105	37	47	3.4	6.8
WkC2---------- Wawasee	95	33	40	3.1	6.2
WmD3---------- Wawasee	---	---	---	2.5	5.0
Wt---------- Whitaker	115	44	50	4.1	8.2

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	13,358	---	---	---
II	174,593	40,545	122,565	11,483
III	57,350	17,854	12,333	27,163
IV	21,117	1,826	7,321	11,970
V	4,102	---	4,102	---
VI	7,116	1,238	---	5,878
VII	368	---	---	368
VIII	3,481	---	3,481	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
Ad---------- Adrian	4w	Slight	Severe	Severe	Severe	White ash----------	51	
						Red maple----------	51	
						Quaking aspen-------	56	
						Black willow--------	---	
						Silver maple--------	76	
AuA---------- Aubbeenaubbee	3o	Slight	Slight	Slight	Slight	White oak----------	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore, green ash.
						Pin oak------------	85	
						Yellow-poplar-------	85	
						Sweetgum-----------	80	
						Northern red oak----	75	
Bd---------- Brady	3s	Slight	Moderate	Slight	Slight	White oak----------	70	Red maple, European larch, eastern white pine.
						Pin oak------------	90	
						Eastern white pine--	70	
						Quaking aspen-------	85	
BeA---------- Brems	3s	Slight	Slight	Severe	Slight	Northern red oak----	70	Eastern white pine, red pine, jack pine.
						Red pine-----------	72	
						Eastern white pine--	65	
						Jack pine----------	70	
BoA---------- Bronson	3s	Slight	Slight	Moderate	Slight	Northern red oak----	70	Eastern white pine, red pine, jack pine.
						Red pine-----------	72	
						Eastern white pine--	85	
						Jack pine----------	70	
Br---------- Brookston	2w	Slight	Severe	Severe	Moderate	Pin oak------------	86	Eastern white pine, red maple, white ash.
						White oak----------	75	
						Sweetgum-----------	90	
						Northern red oak----	78	
ChB, ChC---------- Chelsea	3s	Slight	Slight	Moderate	Slight	White oak----------	70	Eastern white pine, red pine, jack pine.
						Red pine-----------	72	
						Eastern white pine--	83	
						Jack pine----------	70	
						Quaking aspen-------	72	
						Northern red oak----	70	
CtA---------- Crosier	3o	Slight	Slight	Slight	Slight	White oak----------	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak------------	85	
						Yellow-poplar-------	85	
						Sweetgum-----------	80	
						Northern red oak----	75	
Ed---------- Edwards	4w	Slight	Severe	Severe	Severe	White ash----------	51	White ash, red maple, silver maple.
						Red maple----------	51	
						Quaking aspen-------	56	
						Black willow--------	---	
						Silver maple--------	76	
FsA, FsB, FsC2----- Fox	2o	Slight	Slight	Slight	Slight	Northern red oak----	80	Yellow-poplar, white ash, eastern white pine, northern red oak.
						White oak----------	---	
						Sugar maple--------	---	
Gf---------- Gilford	4w	Slight	Severe	Severe	Severe	Pin oak------------	70	Eastern white pine, European larch, white ash, pin oak.
						Eastern white pine--	55	
						Bigtooth aspen------	70	
						Red maple----------	60	
HdB---------- Hillsdale	1o	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, black walnut, yellow-poplar, white ash, white oak.
						Yellow-poplar-------	98	
						Sweetgum-----------	76	

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
Ho---------- Houghton	4w	Slight	Severe	Severe	Severe	White ash----------	51	
						Red maple----------	51	
						Quaking aspen-------	56	
						Black willow--------	---	
						Silver maple--------	76	
LnA, LnB---------- Linkville	---	---	---	---	---	---	---	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
MeA, MeB, MeC2----- Martinsville	1o	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, white ash, yellow-poplar, black walnut, white oak.
						Yellow-poplar-------	98	
						Sweetgum----------	76	
MgB, MgC---------- Metea	2s	Slight	Slight	Moderate	Slight	White oak----------	80	Eastern white pine, red pine, yellow-poplar, black walnut.
						Yellow-poplar-------	86	
						Eastern white pine--	75	
						Red pine----------	75	
Mn---------- Milford	---	---	---	---	---	---	---	Pin oak, green ash, red maple.
Ne---------- Newton	4w	Slight	Severe	Severe	Severe	Pin oak----------	70	Eastern white pine, eastern cottonwood, pin oak.
						Eastern white pine--	55	
						Eastern cottonwood--	70	
OsA, OsB, OsC, OsD- Oshtemo	3s	Slight	Slight	Moderate	Slight	Northern red oak----	66	Eastern white pine, red pine.
						White oak----------	---	
						American basswood---	66	
						Sugar maple---------	61	
OwA---------- Owosso	1o	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, yellow-poplar, black walnut, white oak.
						Yellow-poplar-------	---	
						American beech------	---	
Pa---------- Palms	4w	Slight	Severe	Severe	Severe	White ash----------	51	
						Red maple----------	51	
						Quaking aspen-------	56	
						Black willow--------	---	
						Silver maple--------	76	
PdA---------- Pinhook	2w	Slight	Severe	Moderate	Moderate	Pin oak----------	86	Eastern white pine, red maple, white ash, pin oak.
						White oak----------	75	
						Sweetgum----------	90	
PsA, PsC---------- Plainfield	3s	Slight	Slight	Severe	Slight	Black oak----------	70	Red pine, eastern white pine, jack pine.
						White oak----------	65	
						Black cherry--------	---	
						Scarlet oak---------	68	
						Northern red oak----	---	
PsD---------- Plainfield	3s	Moderate	Severe	Severe	Slight	Black oak----------	70	Red pine, eastern white pine, jack pine.
						White oak----------	65	
						Black cherry--------	---	
						Scarlet oak---------	68	
						Northern red oak----	---	
Re---------- Rensselaer	2w	Slight	Severe	Severe	Severe	Pin oak----------	86	Eastern white pine, Norway spruce, red maple, white ash, pin oak, northern red oak.
						White oak----------	75	
						Sweetgum----------	90	
						Northern red oak----	76	

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
RsA, RsB, RsC2, RsD---------- Riddles	1o	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, white ash, yellow-poplar, black walnut, white oak, northern red oak.
						Yellow-poplar-------	98	
						Sweetgum----------	76	
						Northern red oak----	90	
SpA---------- Shipshe	---	--------	--------	--------	--------	----------	---	Eastern white pine, black walnut, white ash.
St---------- Stonelick	2o	Slight	Slight	Slight	Slight	Northern red oak----	80	Eastern white pine, black walnut, yellow-poplar.
Tx---------- Troxel	---	--------	--------	--------	--------	----------	---	White oak, black walnut, northern red oak, green ash, eastern white pine.
TyA, TyB, TyC------ Tyner	3s	Slight	Slight	Moderate	Slight	White oak----------	70	Eastern white pine, red pine, jack pine.
						Red pine----------	72	
						Eastern white pine--	65	
						Jack pine----------	70	
						Quaking aspen-------	72	
						Northern red oak----	70	
Wa---------- Wallkill	4w	Slight	Severe	Severe	Severe	Pin oak----------	80	
						Red maple----------	65	
Wh---------- Washtenaw	2w	Slight	Severe	Severe	Moderate	Pin oak----------	86	Eastern white pine, red maple, white ash, pin oak, northern red oak.
						Northern red oak----	75	
						Sweetgum----------	90	
						Red maple----------	70	
						Silver maple--------	---	
						White ash----------	---	
						American basswood---	---	
						White oak----------	---	
WkB, WkC2, WmD3---- Wawasee	1o	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, white ash, yellow-poplar, black walnut, white oak.
						Yellow-poplar-------	98	
						Sweetgum----------	72	
Wt---------- Whitaker	3o	Slight	Slight	Slight	Slight	White oak----------	70	Eastern white pine, white ash, red maple, yellow-poplar, pin oak northern red oak.
						Pin oak----------	85	
						Yellow-poplar-------	85	
						Sweetgum----------	80	
						Northern red oak----	75	

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ad---------- Adrian	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Tall purple willow, medium purple willow.	Northern white-cedar.	Lombardy poplar.
AuA---------- Aubbeenaubbee	---	Autumn-olive, Amur honeysuckle, blackhaw, mapleleaf viburnum, cornelian cherry dogwood, American cranberrybush, shadblow serviceberry, rose-of-sharon.	---	Norway spruce, white spruce, American basswood.	Eastern white pine.
Bd---------- Brady	Gray dogwood, dwarf purple willow.	Redosier dogwood, silky dogwood.	Tall purple willow	Eastern white pine, pin oak.	---
BeA---------- Brems	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	Austrian pine, tall purple willow.	Eastern white pine, red pine, jack pine.	---
BoA---------- Bronson	American hazel, European privet.	Tamarisk, late lilac, forsythia.	Red pine, Austrian pine.	Eastern white pine, jack pine, tall purple willow, autumn-olive.	---
Br---------- Brookston	Gray dogwood, dwarf purple willow.	Redosier dogwood, Amur honeysuckle, silky dogwood.	Northern white-cedar, medium purple willow, tall purple willow, Siberian crabapple.	---	Green ash, Lombardy poplar.
ChB, ChC---------- Chelsea	Siberian peashrub, gray dogwood, Koster redcedar.	Nannyberry viburnum, eastern redcedar, Russian-olive, Siberian crabapple.	Common hackberry, eastern white pine, red pine.	---	---
CtA---------- Crosier	Cutleaf staghorn sumac.	Blackhaw, autumn-olive, Amur honeysuckle, mapleleaf viburnum, cornelian cherry dogwood, American cranberrybush, rose-of-sharon.	---	Norway spruce, American basswood, white spruce.	Eastern white pine.
Ed---------- Edwards	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
EsA---------- Elston	Mockorange--------	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock---	---	Eastern white pine, Norway spruce, honeylocust.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Fc*. Fluvaquents					
FsA, FsB, FsC2---- Fox	---	Autumn-olive, Amur honeysuckle, blackhaw, shadblow serviceberry, American cranberrybush, cornelian cherry dogwood.	---	Norway spruce, white spruce, American basswood.	Eastern white pine.
Gf---------- Gilford	Gray dogwood, dwarf purple willow.	Redosier dogwood, hawthorn, silky dogwood, shadblow serviceberry.	Northern white-cedar, tall purple willow, laurel willow.	Pin oak, eastern white pine.	Lombardy poplar.
HdB---------- Hillsdale	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	Austrian pine-----	Eastern white pine, red pine, jack pine.	---
Ho---------- Houghton	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Hp. Houghton					
LnA, LnB---------- Linkville	Mockorange--------	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock---	Norway spruce-----	Honeylocust, eastern white pine.
MeA, MeB, MeC2---- Martinsville	Mockorange--------	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock---	Norway spruce-----	Eastern white pine, honeylocust.
MgB, MgC---------- Metea	American hazel, European privet.	Forsythia, late lilac, tamarisk, autumn-olive.	---	Red pine, eastern white pine, jack pine, Austrian pine.	---
Mn---------- Milford	Redosier dogwood, gray dogwood.	Oriental arborvitae, Amur maple, silky dogwood.	Russian-olive, baldcypress.	Green ash, Norway spruce.	Eastern cottonwood, pin oak, American sycamore.
Ne---------- Newton	Gray dogwood------	Redosier dogwood, silky dogwood, dwarf purple willow.	Tall purple willow	Pin oak, eastern white pine.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
OsA, OsB, OsC, OsD---------- Oshtemo	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
OwA---------- Owosso	Mockorange--------	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	---	Norway spruce, eastern hemlock.	Eastern white pine, honeylocust.
Pa---------- Palms	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
PdA---------- Pinhook	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
PsA, PsC, PsD----- Plainfield	American hazel----	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
Re---------- Rensselaer	Gray dogwood, dwarf purple willow.	Redosier dogwood, Amur honeysuckle, silky dogwood.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.
RsA, RsB, RsC2, RsD---------- Riddles	Mockorange--------	European burningbush, blackhaw, lilac, Amur honeysuckle, American cranberrybush.	Eastern hemlock---	Norway spruce-----	Eastern white pine, honeylocust.
SpA---------- Shipshe	Mockorange--------	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock---	Norway spruce-----	Eastern white pine, honeylocust.
St---------- Stonelick	Tatarian honeysuckle, Amur honeysuckle, wayfaringtree, winged euonymus.	Scotch pine, nannyberry viburnum, autumn-olive.	Austrian pine, eastern redcedar, red pine.	Eastern white pine	---
Tx---------- Troxel	Gray dogwood, redosier dogwood.	Silky dogwood, autumn-olive, Amur honeysuckle.	Eastern redcedar, Russian-olive.	Norway spruce, Douglas-fir, eastern white pine.	Eastern cottonwood, American sycamore.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
TyA, TyB, TyC----- Tyner	American hazel, European privet.	Autumn-olive, forsythia, late lilac, tamarisk.	---	Red pine, eastern white pine, jack pine, Austrian pine.	---
Ua*. Udorthents					
Wa----------- Wallkill	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Wh----------- Washtenaw	Gray dogwood, dwarf purple willow.	Redosier dogwood, silky dogwood, Amur honeysuckle.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.
WkB, WkC2, WmD3--- Wawasee	---	Blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, winged euonymus, American cranberrybush, autumn-olive.	Eastern hemlock, European burningbush.	Norway spruce-----	Honeylocust, eastern white pine.
Wt----------- Whitaker	---	Autumn-olive, Amur honeysuckle, American cranberrybush, blackhaw, shadblow serviceberry, arrowwood, cornelian cherry dogwood, rose-of-sharon.	---	Norway spruce, white spruce, American basswood.	Eastern white pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ad Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
AuA Aubbeenaubbee	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Bd Brady	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
BeA Brems	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
BoA Bronson	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
Br Brookston	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
ChB Chelsea	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
ChC Chelsea	Severe: too sandy.	Severe: too sandy.	Severe: too sandy, slope.	Severe: too sandy.	Moderate: droughty.
CtA Crosier	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Ed Edwards	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
EsA Elston	Slight	Slight	Slight	Slight	Slight.
Fc*. Fluvaquents					
FsA Fox	Slight	Slight	Slight	Slight	Slight.
FsB Fox	Slight	Slight	Moderate: slope.	Slight	Slight.
FsC2 Fox	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Gf Gilford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
HdB Hillsdale	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Ho Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excuss humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Hp Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
LnA Linkville	Slight	Slight	Slight	Slight	Slight.
LnB Linkville	Slight	Slight	Moderate: slope.	Slight	Slight.
MeA Martinsville	Slight	Slight	Slight	Severe: erodes easily.	Slight.
MeB Martinsville	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
MeC2 Martinsville	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
MgB Metea	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
MgC Metea	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Mn Milford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ne Newton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
OsA, OsB Oshtemo	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
OsC Oshtemo	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, slope.
OsD Oshtemo	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
OwA Owosso	Slight	Slight	Moderate: small stones.	Slight	Slight.
Pa Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
PdA Pinhook	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
PsA Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
PsC Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
PsD Plainfield	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty, slope.
Re Rensselaer	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
RsA---------- Riddles	Slight----------	Slight----------	Moderate: small stones.	Slight----------	Slight.
RsB---------- Riddles	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Slight.
RsC2---------- Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
RsD---------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
SpA---------- Shipshe	Slight----------	Slight----------	Moderate: small stones.	Slight----------	Moderate: droughty.
St---------- Stonelick	Severe: floods.	Moderate: floods, small stones.	Severe: small stones, floods.	Moderate: floods.	Severe: floods.
Tx---------- Troxel	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.
TyA, TyB---------- Tyner	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.
TyC---------- Tyner	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope, droughty.
Ua*. Udorthents					
Wa---------- Wallkill	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Wh---------- Washtenaw	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
WkB---------- Wawasee	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Slight.
WkC2---------- Wawasee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
WmD3---------- Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Wt---------- Whitaker	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ad---------- Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
AuA---------- Aubbeenaubbee	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Bd---------- Brady	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
BeA---------- Brems	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Poor	Poor	Poor.
BoA---------- Bronson	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Br---------- Brookston	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
ChB, ChC---------- Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
CtA---------- Crosier	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ed---------- Edwards	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
EsA---------- Elston	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Fc*. Fluvaquents										
FsA, FsB, FsC2----- Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Gf---------- Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
HdB---------- Hillsdale	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Ho---------- Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Hp---------- Houghton	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
LnA, LnB---------- Linkville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MeA, MeB---------- Martinsville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MeC2---------- Martinsville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MgB---------- Metea	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
MgC---------- Metea	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Mn---------- Milford	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Ne---------- Newton	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
OsA, OsB, OsC, OsD- Oshtemo	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
OwA---------- Owosso	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pa---------- Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Poor.
PdA---------- Pinhook	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
PsA---------- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
PsC, PsD---------- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Re---------- Rensselaer	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
RsA, RsB---------- Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RsC2---------- Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RsD---------- Riddles	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
SpA---------- Shipshe	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
St---------- Stonelick	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Tx---------- Troxel	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
TyA, TyB, TyC------ Tyner	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Ua*. Udorthents										
Wa---------- Wallkill	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Wh---------- Washtenaw	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
WkB---------- Wawasee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WkC2---------- Wawasee	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WmD3---------- Wawasee	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Wt---------- Whitaker	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ad Adrian	Severe: ponding, cutbanks cave, excess humus.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: excess humus, ponding.
AuA Aubbeenaubbee	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
Bd Brady	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
BeA Brems	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
BoA Bronson	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
Br Brookston	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
ChB Chelsea	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
ChC Chelsea	Severe: cutbanks cave.	Slight	Slight	Severe: slope.	Moderate: slope.	Moderate: droughty.
CtA Crosier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Ed Edwards	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: excess humus, ponding.
EsA Elston	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
Fc*. Fluvaquents						
FsA Fox	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.	Slight.
FsB Fox	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell.	Slight.
FsC2 Fox	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
Gf Gilford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
HdB Hillsdale	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ho---- Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: excess humus, ponding.
Hp---- Houghton	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
LnA---- Linkville	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
LnB---- Linkville	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
MeA---- Martinsville	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.	Slight.
MeB---- Martinsville	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.	Slight.
MeC2---- Martinsville	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
MgB---- Metea	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
MgC---- Metea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Mn---- Milford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Ne---- Newton	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
OsA, OsB---- Oshtemo	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Slight----	Moderate: small stones.
OsC---- Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, slope.
OsD---- Oshtemo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
OwA---- Owosso	Slight----	Slight----	Slight----	Slight----	Moderate: frost action.	Slight.
Pa---- Palms	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, excess humus.
PdA---- Pinhook	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action, low strength.	Severe: wetness.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PsA--- Plainfield	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Slight---	Severe: droughty.
PsC--- Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
PsD--- Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Re--- Rensselaer	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
RsA--- Riddles	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.	Slight.
RsB--- Riddles	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: low strength, frost action.	Slight.
RsC2--- Riddles	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
RsD--- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
SpA--- Shipshe	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Moderate: frost action.	Moderate: droughty.
St--- Stonelick	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Tx--- Troxel	Slight---	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Moderate: ponding.
TyA, TyB--- Tyner	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Slight---	Moderate: droughty.
TyC--- Tyner	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
Ua* Udorthents						
Wa--- Wallkill	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
Wh--- Washtenaw	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
WkB--- Wawasee	Slight---	Slight---	Slight---	Moderate: slope.	Moderate: frost action, low strength.	Slight.
WkC2--- Wawasee	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
WmD3---------- Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Wt---------- Whitaker	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ad Adrian	Severe: ponding.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Severe: ponding, seepage.	Poor: ponding, excess humus.
AuA Aubbeenaubbee	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
Bd Brady	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
BeA Brems	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
BoA Bronson	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage.
Br Brookston	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding, hard to pack.
ChB Chelsea	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
ChC Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
CtA Crosier	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ed Edwards	Severe: ponding, percs slowly.	Severe: ponding, seepage, excess humus.	Severe: ponding.	Severe: ponding, seepage.	Poor: ponding.
EsA Elston	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Fc*. Fluvaquents					
FsA, FsB Fox	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
FsC2 Fox	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Gf Gilford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HdB---------- Hillsdale	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Ho---------- Houghton	Severe: ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
Hp---------- Houghton	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
LnA, LnB---------- Linkville	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight----------	Fair: too clayey.
MeA---------- Martinsville	Slight----------	Moderate: seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey, thin layer.
MeB---------- Martinsville	Slight----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey, thin layer.
MeC2---------- Martinsville	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, thin layer.
MgB---------- Metea	Moderate: percs slowly.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MgC---------- Metea	Moderate: slope, percs slowly.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Mn---------- Milford	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Ne---------- Newton	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, seepage, ponding.
OsA, OsB---------- Oshtemo	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
OsC---------- Oshtemo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
OsD---------- Oshtemo	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, slope.
OwA---------- Owosso	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
Pa---------- Palms	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PdA---------- Pinhook	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness, thin layer.
PsA---------- Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PsC---------- Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PsD---------- Plainfield	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
Re---------- Rensselaer	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
RsA---------- Riddles	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
RsB---------- Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
RsC2---------- Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
RsD---------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
SpA---------- Shipshe	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
St---------- Stonelick	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Poor: seepage.
Tx---------- Troxel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Good.
TyA, TyB---------- Tyner	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
TyC---------- Tyner	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Ua*. Udorthents					
Wa---------- Wallkill	Severe: ponding.	Severe: ponding, seepage.	Severe: ponding, seepage.	Severe: ponding, seepage.	Poor: ponding.
Wh---------- Washtenaw	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
WkB---------- Wawasee	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
WkC2---------- Wawasee	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
WmD3---------- Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Wt---------- Whitaker	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ad Adrian	Poor: wetness, low strength.	Probable	Improbable: too sandy.	Poor: wetness, excess humus.
AuA Aubbeenaubbee	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Bd Brady	Fair: wetness.	Probable	Probable	Poor: small stones.
BeA Brems	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
BoA Bronson	Fair: wetness.	Probable	Probable	Poor: small stones.
Br Brookston	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
ChB, ChC Chelsea	Good	Probable	Improbable: too sandy.	Poor: too sandy.
CtA Crosier	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Ed Edwards	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
EsA Elston	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
Fc*. Fluvaquents				
FsA, FsB, FsC2 Fox	Good	Probable	Probable	Poor: small stones, area reclaim.
Gf Gilford	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
HdB Hillsdale	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Ho Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
Hp Houghton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
LnA, LnB Linkville	Good	Probable	Probable	Fair: small stones, thin layer.
MeA, MeB Martinsville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MeC2--- Martinsville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
MgB--- Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy.
MgC--- Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, slope.
Mn--- Milford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ne--- Newton	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
OsA, OsB, OsC--- Oshtemo	Good	Probable	Probable	Poor: small stones.
OsD--- Oshtemo	Fair: slope.	Probable	Probable	Poor: small stones, slope.
OwA--- Owosso	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Pa--- Palms	Poor: wetness, low strength.	Improbable: excess humus, excess fines.	Improbable: excess humus, excess fines.	Poor: wetness, excess humus.
PdA--- Pinhook	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
PsA, PsC--- Plainfield	Good	Probable	Improbable: too sandy.	Poor: too sandy.
PsD--- Plainfield	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
Re--- Rensselaer	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
RsA, RsB--- Riddles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
RsC2--- Riddles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
RsD--- Riddles	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
SpA--- Shipshe	Good	Probable	Probable	Poor: small stones, area reclaim.
St--- Stonelick	Good	Probable	Improbable: too sandy.	Poor: small stones.
Tx--- Troxel	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
TyA, TyB, TyC--- Tyner	Good	Probable	Improbable: too sandy.	Poor: thin layer.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ua*. Udorthents				
Wa Wallkill	Poor: low strength, frost action, excess humus.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Wh Washtenaw	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
WkB Wawasee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WkC2 Wawasee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
WmD3 Wawasee	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Wt Whitaker	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Ad---------- Adrian	Severe: seepage.	Severe: seepage, ponding, excess humus.	Severe: slow refill, cutbanks cave.	Ponding, frost action, subsides.	Ponding, soil blowing, too sandy.	Wetness.
AuA---------- Aubbeenaubbee	Severe: seepage.	Severe: wetness.	Severe: cutbanks cave.	Frost action---	Wetness, soil blowing.	Wetness.
Bd---------- Brady	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness, soil blowing.	Wetness.
BeA---------- Brems	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
BoA---------- Bronson	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Favorable.
Br---------- Brookston	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
ChB, ChC---------- Chelsea	Severe: seepage.	Severe: piping, seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
CtA---------- Crosier	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness--------	Wetness.
Ed---------- Edwards	Severe: seepage.	Severe: ponding.	Severe: slow refill.	Frost action, ponding, subsides.	Ponding, soil blowing.	Wetness.
EsA---------- Elston	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Soil blowing, too sandy.	Favorable.
Fc*. Fluvaquents						
FsA, FsB---------- Fox	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Rooting depth.
FsC2---------- Fox	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, rooting depth.
Gf---------- Gilford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness, rooting depth.
HdB---------- Hillsdale	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Soil blowing---	Rooting depth.
Ho---------- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
Hp---------- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding--------	Wetness.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
LnA---------- Linkville	Moderate: seepage.	Slight----------	Severe: no water.	Deep to water	Soil blowing---	Favorable.
LnB---------- Linkville	Moderate: seepage, slope.	Slight----------	Severe: no water.	Deep to water	Soil blowing---	Favorable.
MeA---------- Martinsville	Moderate: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
MeB---------- Martinsville	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
MeC2---------- Martinsville	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
MgB---------- Metea	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
MgC---------- Metea	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
Mn---------- Milford	Slight----------	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Ne---------- Newton	Severe: seepage.	Severe: piping, seepage, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness, droughty.
OsA, OsB---------- Oshtemo	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Favorable.
OsC, OsD---------- Oshtemo	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope.
OwA---------- Owosso	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Soil blowing---	Favorable.
Pa---------- Palms	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action, subsides.	Ponding, soil blowing.	Wetness.
PdA---------- Pinhook	Severe: seepage.	Severe: wetness, piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, rooting depth.
PsA---------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
PsC, PsD---------- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Droughty, slope.
Re---------- Rensselaer	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, frost action.	Ponding, too sandy.	Wetness, percs slowly.
RsA---------- Riddles	Moderate: seepage.	Slight----------	Severe: no water.	Deep to water	Soil blowing---	Favorable.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
RsB---------- Riddles	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Soil blowing---	Favorable.
RsC2, RsD--------- Riddles	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
SpA---------- Shipshe	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty, rooting depth.
St---------- Stonelick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
Tx---------- Troxel	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
TyA, TyB---------- Tyner	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
TyC---------- Tyner	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
Ua*. Udorthents						
Wa---------- Wallkill	Severe: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	Ponding, poor outlets, frost action.	Ponding--------	Wetness.
Wh---------- Washtenaw	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Percs slowly, frost action, ponding.	Ponding, erodes easily.	Wetness, percs slowly, erodes easily.
WkB---------- Wawasee	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Soil blowing---	Favorable.
WkC2---------- Wawasee	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
WmD3---------- Wawasee	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope----------	Slope.
Wt---------- Whitaker	Moderate: seepage.	Severe: wetness.	Moderate: slow refill, cutbanks cave.	Frost action---	Erodes easily, wetness.	Wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ad	0-35	Sapric material	Pt	A-8	---	---	---	---	---	---	---
Adrian	35-60	Sand, loamy sand, fine sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
AuA	0-13	Sandy loam	SM, SM-SC	A-2-4, A-4	0	100	75-100	50-80	30-50	<25	NP-6
Aubbeenaubbee	13-19	Sandy loam, loam, loamy sand.	SM	A-2-4, A-1-b, A-4	0	100	75-100	40-75	15-60	<20	NP
	19-52	Sandy clay loam, clay loam, loam.	CL, SC	A-6, A-2-6	0	95-100	90-100	80-95	30-60	25-35	11-16
	52-60	Loam	CL, CL-ML, ML	A-4, A-6	0-3	85-90	80-100	70-95	50-70	20-35	2-14
Bd	0-9	Sandy loam	SM, SM-SC	A-2, A-4	0-5	95-100	75-100	60-70	25-40	<25	NP-7
Brady	9-36	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	95-100	75-95	60-80	25-45	15-35	NP-16
	36-48	Loamy sand, sandy loam.	SM	A-2	0-5	95-100	75-95	55-70	15-35	---	NP
	48-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-5	40-75	35-70	20-55	0-10	---	NP
BeA	0-8	Sand	SM, SP-SM	A-2-4, A-3	0	100	85-100	50-85	5-15	---	NP
Brems	8-48	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-25	---	NP
	48-60	Sand, fine sand, loamy sand.	SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-10	---	NP
BoA	0-14	Loamy sand	SM	A-2	0-5	95-100	90-100	50-70	15-25	---	NP
Bronson	14-36	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	95-100	60-95	60-85	25-45	<30	NP-15
	36-46	Loamy sand, gravelly loamy sand.	SM, SP-SM	A-2	0-5	85-95	60-95	55-70	10-15	---	NP
	46-60	Sand and gravel	SP, GP, SP-SM, GP-GM	A-1, A-2, A-3	0-10	40-90	35-85	20-60	0-10	---	NP
Br	0-14	Loam	CL	A-4, A-6	0	98-100	98-100	85-100	60-90	22-40	8-18
Brookston	14-48	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	98-100	85-100	75-95	60-85	36-52	18-30
	48-60	Loam, sandy loam, clay loam.	CL	A-4, A-6	0-3	90-100	85-95	78-90	55-70	22-30	7-15
ChB, ChC	0-7	Fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
Chelsea	7-80	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
CtA	0-12	Loam	CL	A-4, A-6	0	100	95-100	85-95	60-80	22-33	8-15
Crosier	12-26	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-95	85-95	75-90	60-70	33-47	15-26
	26-60	Loam	CL, ML	A-4, A-6	0-3	85-90	80-88	70-85	50-60	25-35	2-12
Ed	0-20	Sapric material	Pt	A-8	0	---	---	---	---	---	---
Edwards	20-60	Marl	---	---	0	100	95-100	80-90	60-80	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
EsA---------- Elston	0-14	Sandy loam------	SM	A-2, A-4	0	100	100	60-70	30-40	<30	NP-6
	14-24	Sandy loam, loam, sandy clay loam.	SM, CL, SC, ML	A-4, A-6	0	95-100	75-95	50-80	35-65	<30	NP-15
	24-53	Gravelly loamy sand, gravelly sandy loam.	SP-SM, SM, SC, SM-SC	A-2-4, A-3, A-1-b	0-3	95-100	75-95	45-75	5-30	<25	NP-10
	53-60	Stratified coarse sand and gravelly sand.	SP-SM, SM	A-3, A-2-4, A-1-b	0-3	95-100	70-95	40-70	5-25	---	NP
Fc*. Fluvaquents											
FsA, FsB, FsC2----- Fox	0-12	Sandy loam------	SM, SM-SC	A-4, A-2	0	95-100	90-100	55-75	30-45	<20	2-7
	12-35	Clay loam, loam, gravelly clay loam.	CL, SC	A-2, A-6, A-7	0-5	85-100	75-95	50-95	20-65	25-45	10-25
	35-60	Sand and gravel	SP, SM, GP, GM	A-1, A-2, A-3	0-10	40-100	35-100	15-95	2-20	---	NP
Gf---------- Gilford	0-14	Sandy loam------	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	14-24	Sandy loam, fine sandy loam.	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	20-35	15-30	NP-8
	24-60	Loamy sand, sand	SM, SP, SP-SM	A-3, A-1-b, A-2-4	0	90-100	85-100	18-60	3-20	---	NP
HdB---------- Hillsdale	0-14	Sandy loam------	SM, SC, ML, CL	A-2-4, A-4	0-5	95-100	85-100	60-90	20-65	15-30	2-10
	14-28	Sandy loam------	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	85-100	60-85	15-50	15-30	2-10
	28-50	Sandy loam, sandy clay loam, loam.	SM, SC, SM-SC	A-2-4, A-2-6, A-4, A-6	0-5	95-100	85-100	65-85	30-50	12-38	2-19
	50-60	Sandy loam, loamy sand.	SM, SC, SM-SC	A-2-4, A-4	0-5	95-100	85-100	55-80	25-40	15-22	3-8
Ho, Hp---------- Houghton	0-60	Sapric material	Pt	A-8	0	---	---	---	---	---	---
LnA, LnB---------- Linkville	0-13	Sandy loam------	SM-SC, SC	A-2-4, A-4	0	90-100	85-95	55-70	30-45	20-30	4-10
	13-66	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	80-95	65-90	35-55	30-45	10-22
	66-77	Gravelly sandy loam.	SM-SC, SC	A-2-4, A-4	0	85-95	65-95	40-65	25-45	20-30	4-10
	77-80	Stratified sand to gravelly sand.	GP, GP-GM, SP, SP-SM	A-1	0-5	40-70	35-65	20-45	3-12	---	NP
MeA, MeB, MeC2----- Martinsville	0-18	Loam----------	CL, CL-ML	A-4, A-6	0	100	90-100	80-100	60-90	22-33	4-12
	18-37	Clay loam, silty clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	90-100	65-90	40-90	20-35	8-20
	37-53	Sandy loam, sandy clay loam, loam.	SM, ML	A-2-4, A-4	0	100	90-100	60-80	30-60	30-40	2-8
	53-80	Sandy loam, loamy sand, silt loam.	CL, SC, CL-ML, SM-SC	A-4	0	95-100	85-100	80-95	40-80	<25	4-9

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MgB---------- Metea	0-9	Loamy fine sand	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	9-28	Loamy sand, fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	28-44	Clay loam, sandy loam, silty clay loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	44-60	Loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18
MgC---------- Metea	0-10	Loamy fine sand	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	10-29	Loamy sand, fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	29-42	Clay loam, sandy loam, silty clay loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	42-60	Loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18
Mn---------- Milford	0-13	Silty clay loam	CL, CH	A-7	0	100	95-100	90-100	80-95	40-60	20-35
	13-42	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	95-100	90-100	75-100	40-60	20-40
	42-60	Silty clay loam, sandy loam.	CL	A-6, A-7	0	97-100	95-100	90-100	70-100	30-50	15-30
Ne---------- Newton	0-22	Loamy fine sand, loamy sand.	SM, SM-SC	A-2-4	0	100	100	50-75	15-30	<20	NP-5
	22-60	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-2-4, A-3	0	100	100	50-75	5-25	---	NP
OsA, OsB, OsC, OsD---------- Oshtemo	0-14	Loamy sand	SM	A-2, A-1	0	95-100	60-95	40-70	15-30	---	NP
	14-36	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	36-50	Gravelly loamy sand.	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	50-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
OwA---------- Owosso	0-9	Sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	85-100	50-85	25-50	15-29	NP-10
	9-24	Fine sandy loam, sandy loam.	SM, SM-SC, SC	A-2, A-4, A-6	0-5	95-100	85-100	50-85	25-50	15-35	3-15
	24-49	Loam, clay loam, sandy clay loam.	CL-ML, CL, SM-SC, SC	A-4, A-6	0	80-95	80-95	70-90	35-70	25-40	6-20
	49-60	Loam, sandy loam	CL-ML, CL, SM-SC, SC	A-4, A-2-4	0	75-95	75-95	50-85	30-65	20-30	4-10
Pa---------- Palms	0-26	Sapric material	Pt	---	---	---	---	---	---	---	---
	26-60	Clay loam, sandy clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PdA---------- Pinhook	0-14	Sandy loam------	SC, SM-SC, SM	A-2-4, A-4	0	90-100	85-95	55-70	20-40	20-30	2-10
	14-35	Sandy loam, loamy sand.	SC, CL, SM, ML	A-6, A-4, A-2-4	0	95-100	85-95	65-90	30-70	15-35	NP-15
	35-62	Stratified gravelly sandy loam to sand.	SM, SP-SM, SW-SM	A-3, A-2-4	0-5	80-100	70-100	50-85	5-25	---	NP
PsA, PsC, PsD------ Plainfield	0-7	Sand----------	SP-SM, SM, SP	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	---	NP
	7-60	Sand----------	SP	A-3, A-1, A-2	0	75-100	75-100	40-70	1-4	---	NP
Re---------- Rensselaer	0-15	Loam----------	CL, ML	A-4, A-6	0	100	100	90-100	70-90	27-36	4-12
	15-38	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	80-100	60-80	33-47	15-26
	38-42	Loam----------	CL, SC	A-6	0	95-100	90-100	75-95	35-55	25-35	11-16
	42-60	Stratified fine sand to clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-2	0	95-100	90-100	60-95	20-70	<30	4-9
RsA, RsB, RsC2, RsD---------- Riddles	0-13	Sandy loam, loam	SM, SC, SM-SC	A-2-4, A-4	0	95-100	85-95	50-70	25-40	20-30	2-10
	13-24	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	24-48	Clay loam, sandy clay loam.	CL	A-6, A-7	0	90-100	80-95	75-95	65-75	35-50	15-30
	48-60	Clay loam, sandy loam, loam.	CL, SM, SC, ML	A-4, A-6, A-2	0-3	85-95	80-90	50-90	30-70	15-30	2-15
SpA---------- Shipshe	0-15	Sandy loam------	SC, SM-SC, SM	A-2-4, A-2-6, A-4, A-6	0-2	90-100	75-100	45-70	20-40	<25	NP-12
	15-26	Gravelly sandy loam, very gravelly sandy clay loam, gravelly clay loam.	GC, GW-GM, GM, GP-GM	A-2, A-1, A-4, A-6	0-2	30-60	25-50	15-50	5-40	<25	NP-12
	26-60	Stratified sandy loam to very gravelly sand.	SW, GP, SP, GW	A-1	1-5	30-70	20-55	5-20	2-10	---	NP
St---------- Stonelick	0-9	Sandy loam------	SM, ML, SM-SC	A-4, A-2	0	85-100	70-100	45-75	25-55	<24	NP-6
	9-60	Stratified silt loam to sandy loam.	SM, SP-SM	A-2, A-4, A-3, A-1-b	0	85-100	70-95	40-60	5-40	<15	NP
Tx---------- Troxel	0-27	Silt loam-------	CL, CL-ML	A-6, A-4	0	100	100	95-100	85-95	25-40	5-20
	27-75	Clay loam, loam.	CL	A-6, A-7	0	100	95-100	85-95	70-95	30-50	15-30
	75-80	Stratified loam to gravelly sand.	SM-SC, CL, SC, CL-ML	A-4, A-6, A-2	0	85-100	80-100	70-95	30-80	25-40	5-20

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
TyA, TyB, TyC------ Tyner	0-7	Loamy sand------	SM	A-2-4	0	90-100	85-95	50-75	15-25	---	NP
	7-36	Sand, loamy sand	SM, SP-SM	A-2-4	0	90-100	85-95	50-70	10-30	---	NP
	36-60	Fine sand, sand	SM, SP-SM	A-3, A-2-4	0-5	80-95	70-90	50-70	5-25	---	NP
Ua*. Udorthents											
Wa---------- Wallkill	0-9	Loam----------	ML, SM, OL	A-5, A-7	0	95-100	90-100	70-100	40-90	40-50	5-15
	9-20	Silt loam, loam, mucky silt loam.	CL, CL-ML, SM-SC, SC	A-4	0	75-100	70-100	60-100	40-90	15-25	5-10
	20-60	Sapric material, hemic material.	Pt	A-8	0	---	---	---	---	---	---
Wh---------- Washtenaw	0-10	Silt loam-------	ML, CL	A-4, A-6	0	100	100	90-100	70-90	27-36	4-12
	10-30	Silt loam, loam	CL, ML	A-6, A-4	0	100	100	90-100	70-90	27-36	4-12
	30-58	Silty clay loam, clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	36-50	15-28
	58-66	Clay loam-------	CL	A-4, A-6	0-3	90-100	85-95	80-95	60-75	22-33	8-15
WkB, WkC2---------- Wawasee	0-10	Sandy loam------	SM, SM-SC	A-2-4, A-4	0	90-95	85-95	80-95	30-50	<25	NP-6
	10-39	Loam, sandy clay loam.	CL, SC	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	39-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	75-95	70-95	50-90	25-66	20-30	4-12
WmD3---------- Wawasee	0-6	Sandy clay loam	SC, CL	A-4, A-6	0	90-95	85-95	70-85	35-55	25-35	7-15
	6-27	Loam, sandy clay loam.	CL, SC	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	27-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	75-95	70-95	50-90	25-66	20-30	4-12
Wt---------- Whitaker	0-17	Loam----------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	60-90	22-33	4-12
	17-39	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	100	95-100	90-100	70-80	30-47	12-26
	39-60	Stratified coarse sand to clay.	CL, SC, ML, SM	A-4	0	98-100	98-100	60-85	40-60	15-25	3-9

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cm³	In/hr	In/in	pH	mmhos/cm					Pct
Ad	0-35	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.8	<2	---	---	---	3	55-75
Adrian	35-60	2-10	1.40-1.75	6.0-20	0.03-0.08	5.6-8.4	<2	Low	---			
AuA	0-13	8-15	1.30-1.45	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low	0.24	5	3	1-2
Aubbeenaubbee	13-19	7-15	1.40-1.60	6.0-20	0.09-0.14	5.1-6.5	<2	Low	0.24			
	19-52	22-30	1.40-1.55	0.6-2.0	0.16-0.18	5.6-7.3	<2	Moderate	0.32			
	52-60	8-30	1.40-1.55	0.6-2.0	0.10-0.19	7.4-8.4	<2	Low	0.32			
Bd	0-9	2-15	1.25-1.41	2.0-6.0	0.12-0.15	5.6-7.3	<2	Low	0.20	5	3	1-4
Brady	9-36	5-22	1.35-1.45	2.0-6.0	0.12-0.17	5.1-6.5	<2	Low	0.20			
	36-48	5-20	1.25-1.50	2.0-20	0.08-0.10	5.1-6.5	<2	Low	0.20			
	48-60	0-10	1.25-1.50	6.0-20	0.02-0.04	6.6-8.4	<2	Low	0.10			
BeA	0-8	2-6	1.50-1.65	6.0-20	0.07-0.09	5.1-6.5	<2	Low	0.17	5	1	.5-1
Brems	8-48	2-6	1.60-1.75	6.0-20	0.05-0.08	4.5-6.0	<2	Low	0.17			
	48-60	2-6	1.60-1.75	6.0-20	0.05-0.07	5.1-6.5	<2	Low	0.17			
BoA	0-14	2-12	1.14-1.60	6.0-20	0.10-0.12	5.1-6.0	<2	Low	0.17	4	2	.5-3
Bronson	14-36	10-20	1.26-1.59	2.0-6.0	0.12-0.18	5.1-6.0	<2	Low	0.24			
	36-46	0-10	1.26-1.59	6.0-20	0.06-0.08	5.1-7.3	<2	Low	0.17			
	46-60	0-5	1.20-1.47	>20.0	0.02-0.04	7.4-8.4	<2	Low	0.10			
Br	0-14	18-27	1.35-1.50	0.6-2.0	0.21-0.24	6.6-7.3	<2	Moderate	0.28	5	6	3-5
Brookston	14-48	27-35	1.40-1.60	0.6-2.0	0.15-0.19	6.6-7.3	<2	Moderate	0.28			
	48-60	15-32	1.45-1.70	0.6-2.0	0.05-0.19	7.4-8.4	<2	Moderate	0.28			
ChB, ChC	0-7	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	<2	Low	0.17	5	2	.5-1
Chelsea	7-80	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-5.5	<2	Low	0.17			
CtA	0-12	7-18	1.40-1.55	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low	0.32	5	5	1-3
Crosier	12-26	18-35	1.40-1.60	0.2-0.6	0.15-0.19	5.6-7.3	<2	Moderate	0.32			
	26-60	10-20	1.40-1.60	0.2-0.6	0.10-0.19	7.9-8.4	<2	Low	0.32			
Ed	0-20	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.8	<2	---	---	---	3	55-75
Edwards	20-60	---	---	---	---	7.4-8.4	<2	---	---			
EsA	0-14	8-18	1.35-1.55	2.0-6.0	0.12-0.15	5.6-6.0	<2	Low	0.20	4	3	1-5
Elston	14-24	10-23	1.35-1.60	2.0-6.0	0.12-0.18	4.5-6.0	<2	Low	0.20			
	24-53	4-10	1.45-1.65	2.0-6.0	0.08-0.13	5.6-6.0	<2	Low	0.20			
	53-60	1-5	1.60-1.75	>20	0.05-0.07	7.4-8.4	<2	Low	0.15			
Fc*.												
Fluvaquents												
FsA, FsB, FsC2	0-12	5-15	1.40-1.70	0.6-2.0	0.13-0.15	5.1-7.3	<2	Low	0.24	4	3	1-3
Fox	12-35	18-30	1.55-1.65	0.6-2.0	0.15-0.19	5.6-7.8	<2	Moderate	0.32			
	35-60	0-2	1.30-2.20	6.0-20	0.02-0.04	7.9-8.4	<2	Low	0.10			
Gf	0-14	10-20	1.50-1.70	2.0-6.0	0.13-0.15	6.1-7.3	<2	Low	0.20	4	3	2-4
Gilford	14-24	8-17	1.60-1.80	2.0-6.0	0.12-0.14	6.1-7.3	<2	Low	0.20			
	24-60	3-12	1.70-1.90	6.0-20	0.05-0.08	6.6-8.4	<2	Low	0.15			
HdB	0-14	2-15	1.10-1.64	0.6-6.0	0.13-0.22	5.1-7.3	<2	Low	0.24	5	3	1-3
Hillsdale	14-28	5-15	1.22-1.87	2.0-6.0	0.13-0.15	4.5-6.5	<2	Low	0.24			
	28-50	10-22	1.22-1.87	0.6-2.0	0.12-0.18	4.5-6.5	<2	Low	0.24			
	50-60	0-15	1.31-1.99	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low	0.24			
Ho	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	<2	---	---	---	3	>70
Houghton												
Hp	0-60	---	0.08-0.30	0.2-6.0	0.35-0.45	6.6-7.3	<2	---	---	---	8	>70
Houghton												

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cm³	In/hr	In/in	pH	mmhos/cm					Pct
LnA, LnB--------- Linkville	0-13 13-66 66-77 77-80	8-18 18-30 10-18 2-6	1.35-1.50 1.40-1.60 1.45-1.60 1.60-1.75	0.6-2.0 0.6-2.0 0.6-2.0 6.0-20	0.12-0.14 0.15-0.17 0.08-0.10 0.02-0.04	5.1-7.3 5.1-6.5 5.6-7.3 7.4-8.4	<2 <2 <2 <2	Low-------- Moderate Low-------- Low--------	0.20 0.32 0.10 0.10	5	3	2-4
MeA, MeB, MeC2--- Martinsville	0-18 18-37 37-53 53-80	8-17 18-30 10-25 3-23	1.30-1.45 1.40-1.60 1.40-1.60 1.50-1.70	0.6-2.0 0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.24 0.17-0.20 0.12-0.14 0.19-0.21	5.6-7.3 5.1-6.0 5.6-6.5 7.4-8.4	<2 <2 <2 <2	Low-------- Moderate Low-------- Low--------	0.37 0.37 0.24 0.24	5	5	1-3
MgB-------------- Metea	0-9 9-28 28-44 44-60	3-8 2-10 25-35 20-30	1.45-1.60 1.50-1.70 1.50-1.70 1.40-1.65	>20 >20 0.6-2.0 0.6-2.0	0.10-0.12 0.06-0.11 0.15-0.19 0.05-0.19	5.6-7.3 5.1-7.3 5.6-7.3 7.4-8.4	<2 <2 <2 <2	Low-------- Low-------- Moderate Low--------	0.17 0.17 0.32 0.32	5	2	.5-2
MgC-------------- Metea	0-10 10-29 29-42 42-60	3-8 2-10 25-35 20-30	1.45-1.60 1.50-1.70 1.50-1.70 1.40-1.65	>20 >20 0.6-2.0 0.6-2.0	0.10-0.12 0.06-0.11 0.15-0.19 0.05-0.19	5.6-7.3 5.1-7.3 5.6-7.3 7.4-8.4	<2 <2 <2 <2	Low-------- Low-------- Moderate Low--------	0.17 0.17 0.32 0.32	5	2	.5-2
Mn--------------- Milford	0-13 13-42 42-60	35-42 35-42 20-30	1.35-1.55 1.45-1.65 1.50-1.70	0.6-2.0 0.2-0.6 0.2-0.6	0.12-0.23 0.18-0.20 0.20-0.22	6.1-7.3 5.1-6.5 7.4-8.4	<2 <2 <2	High------- Moderate Moderate	0.28 0.43 0.43	5	4	5-6
Ne--------------- Newton	0-22 22-60	3-7 2-7	1.45-1.60 1.60-1.75	6.0-20 6.0-20	0.10-0.12 0.05-0.07	5.1-6.0 4.5-5.5	<2 <2	Low-------- Low--------	0.17 0.17	5	2	2-4
OsA, OsB, OsC, OsD-------------- Oshtemo	0-14 14-36 36-50 50-60	2-12 10-22 5-15 0-15	1.14-1.60 1.20-1.59 1.20-1.59 1.20-1.47	6.0-20 2.0-6.0 6.0-20 >20	0.10-0.12 0.12-0.19 0.06-0.08 0.02-0.04	5.1-6.5 5.1-6.5 5.1-7.3 7.4-8.4	<2 <2 <2 <2	Low-------- Low-------- Low-------- Low--------	0.24 0.24 0.17 0.10	5	2	.5-3
OwA-------------- Owosso	0-9 9-24 24-49 49-60	10-19 10-19 20-30 15-27	1.40-1.60 1.40-1.60 1.45-1.60 1.45-1.60	0.6-2.0 0.6-2.0 0.6-2.0 0.6-2.0	0.13-0.18 0.12-0.17 0.15-0.19 0.11-0.19	5.1-7.3 5.1-6.5 5.1-7.3 7.4-8.4	<2 <2 <2 <2	Low-------- Low-------- Low-------- Low--------	0.28 0.28 0.28 0.28	5	3	1-3
Pa--------------- Palms	0-26 26-60	--- 7-35	0.25-0.45 1.46-2.00	0.2-6.0 0.2-2.0	0.35-0.45 0.14-0.22	5.1-8.4 6.1-8.4	<2 <2	---------- Low--------	---- ----	---	3	>75
PdA-------------- Pinhook	0-14 14-35 35-62	10-20 8-17 3-12	1.40-1.55 1.60-1.80 1.70-1.90	2.0-6.0 2.0-6.0 6.0-20	0.13-0.15 0.12-0.19 0.05-0.07	4.5-7.3 4.5-5.5 5.1-7.3	<2 <2 <2	Low-------- Low-------- Low--------	0.20 0.32 0.10	4	3	2-4
PsA, PsC, PsD---- Plainfield	0-7 7-60	4-9 1-4	1.35-1.65 1.50-1.65	6.0-20 6.0-20	0.04-0.09 0.04-0.07	4.5-7.3 4.5-6.0	<2 <2	Low-------- Low--------	0.17 0.17	5	1	<1
Re--------------- Rensselaer	0-15 15-38 38-42 42-60	18-27 27-35 25-35 2-30	1.30-1.45 1.40-1.60 1.40-1.60 1.50-1.70	0.2-0.6 0.06-0.2 0.06-0.2 0.6-2.0	0.20-0.24 0.15-0.19 0.16-0.18 0.19-0.21	6.6-7.3 6.1-7.3 7.4-7.8 7.9-8.4	<2 <2 <2 <2	Low-------- Moderate Moderate Low--------	0.28 0.28 0.28 0.28	5	5	2-6
RsA, RsB, RsC2, RsD-------------- Riddles	0-13 13-24 24-48 48-60	4-14 18-35 20-35 8-25	1.35-1.55 1.40-1.60 1.40-1.60 1.40-1.60	2.0-6.0 0.6-2.0 0.6-2.0 0.6-2.0	0.13-0.15 0.16-0.18 0.15-0.19 0.05-0.19	6.1-7.3 5.1-7.3 5.1-7.3 6.6-8.4	<2 <2 <2 <2	Low-------- Moderate Moderate Low--------	0.24 0.32 0.32 0.32	5	3	.5-2
SpA-------------- Shipshe	0-15 15-26 26-60	8-18 14-30 2-5	1.35-1.45 1.40-1.55 1.60-1.80	2.0-6.0 2.0-6.0 >20	0.13-0.15 0.05-0.07 0.02-0.04	5.6-7.3 5.6-6.5 7.9-8.4	<2 <2 <2	Low-------- Low-------- Low--------	0.20 0.10 0.10	3	3	2-5
St--------------- Stonelick	0-9 9-60	8-18 5-18	1.25-1.50 1.20-1.55	2.0-6.0 2.0-6.0	0.09-0.14 0.05-0.11	6.1-6.5 6.1-7.3	<2 <2	Low-------- Low--------	0.24 0.24	5	3	.5-2
Tx--------------- Troxel	0-27 27-75 75-80	20-27 20-35 20-35	1.15-1.35 1.30-1.50 1.35-1.65	0.6-2.0 0.6-2.0 0.6-2.0	0.22-0.24 0.15-0.20 0.09-0.19	5.6-7.3 5.6-6.5 6.6-7.8	<2 <2 <2	Low-------- Moderate Low--------	0.28 0.28 0.28	5	6	3-5

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cm³	In/hr	In/in	pH	mmhos/cm					Pct
TyA, TyB, TyC----	0-7	3-10	1.55-1.70	6.0-20	0.10-0.12	5.1-6.5	<2	Low-------	0.17	5	2	.5-2
Tyner	7-36	3-10	1.55-1.70	6.0-20	0.09-0.11	4.5-6.0	<2	Low-------	0.17			
	36-60	1-6	1.60-1.75	>20	0.05-0.08	5.6-6.0	<2	Low-------	0.17			
Ua*.												
Udorthents												
Wa----------	0-9	10-27	1.15-1.40	0.6-2.0	0.16-0.21	5.1-7.3	<2	Low-------	0.49	3	---	4-12
Wallkill	9-20	15-27	1.15-1.45	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low-------	0.43			
	20-60	---	---	2.0-6.0	0.19-0.22	5.6-7.3	<2	Low-------	----			
Wh----------	0-10	15-27	1.30-1.45	0.6-2.0	0.22-0.24	6.1-7.3	<2	Low-------	0.37	5	5	3-7
Washtenaw	10-30	15-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-------	0.37			
	30-58	28-35	1.40-1.60	0.06-0.2	0.15-0.20	6.1-7.3	<2	Moderate	0.37			
	58-66	15-25	1.45-1.65	0.06-0.2	0.05-0.19	7.4-8.4	<2	Moderate	0.37			
WkB, WkC2--------	0-10	10-18	1.20-1.40	0.6-2.0	0.13-0.15	6.1-7.3	<2	Low-------	0.28	5	3	1-3
Wawasee	10-39	18-27	1.50-1.70	0.6-2.0	0.12-0.18	6.1-7.3	<2	Low-------	0.28			
	39-60	12-18	1.50-1.70	0.6-2.0	0.11-0.18	6.6-8.4	<2	Low-------	0.28			
WmD3----------	0-6	20-27	1.35-1.50	0.6-2.0	0.16-0.19	6.1-7.3	<2	Low-------	0.28	4	5	.5-2
Wawasee	6-27	18-27	1.50-1.70	0.6-2.0	0.12-0.18	6.1-7.3	<2	Low-------	0.28			
	27-60	12-18	1.50-1.70	0.6-2.0	0.11-0.18	6.6-8.4	<2	Low-------	0.28			
Wt----------	0-17	8-17	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low-------	0.37	5	5	1-3
Whitaker	17-39	18-30	1.40-1.60	0.6-2.0	0.15-0.19	5.1-6.0	<2	Moderate	0.37			
	39-60	3-18	1.50-1.70	0.6-6.0	0.19-0.21	6.6-8.4	<2	Low-------	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[The discussions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ad---------- Adrian	A/D	None--------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
AuA---------- Aubbeenaubbee	B	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
Bd---------- Brady	B	None--------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	High-----	Low------	Moderate.
BeA---------- Brems	A	None--------	---	---	2.0-3.0	Apparent	Jan-Apr	>60	---	Low------	Low------	High.
BoA---------- Bronson	B	None--------	---	---	2.0-3.5	Apparent	Nov-May	>60	---	High-----	Low------	High.
Br---------- Brookston	B/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
ChB, ChC---------- Chelsea	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
CtA---------- Crosier	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
Ed---------- Edwards	B/D	None--------	---	---	+.5-0.5	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
EsA---------- Elston	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
Fc*. Fluvaquents												
FsA, FsB, FsC2---- Fox	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Gf---------- Gilford	B/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Moderate.
HdB---------- Hillsdale	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
Ho---------- Houghton	A/D	None--------	---	---	+.5-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
Hp---------- Houghton	D	None--------	---	---	+2-0.5	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
LnA, LnB---------- Linkville	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
MeA, MeB, MeC2---- Martinsville	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
MgB, MgC---------- Metea	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Mn---------------- Milford	B/D	None--------	---	---	+.5-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
Ne---------------- Newton	A/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	Moderate	High-----	High.
OsA, OsB, OsC, OsD---------- Oshtemo	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
OwA---------- Owosso	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Pa---------- Palms	A/D	None--------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
PdA---------- Pinhook	B/D	None--------	---	---	0-1.0	Apparent	Jan-May	>60	---	High-----	High-----	High.
PsA, PsC, PsD----- Plainfield	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
Re---------- Rensselaer	B/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
RsA, RsB, RsC2, RsD---------- Riddles	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
SpA---------- Shipshe	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
St---------- Stonelick	B	Frequent----	Very brief	Nov-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.
Tx---------- Troxel	B	None--------	---	---	+.5-0	---	---	>60	---	High-----	Low------	Moderate.
TyA, TyB, TyC----- Tyner	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
Ua*. Udorthents												
Wa---------- Wallkill	D	None--------	---	---	+.5-0.5	Apparent	Sep-Jun	>60	---	High-----	Moderate	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Wh---------- Washtenaw	C/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
WkB, WkC2, WmD3--- Wawasee	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Wt---------- Whitaker	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Aubbeenaubbee	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Brady	Coarse-loamy, mixed, mesic Aquollic Hapludalfs
*Brems	Mixed, mesic Aquic Udipsamments
Bronson	Coarse-loamy, mixed, mesic Aquic Hapludalfs
Brookston	Fine-loamy, mixed, mesic Typic Argiaquolls
Chelsea	Mixed, mesic Alfic Udipsamments
Crosier	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Edwards	Marly, euic, mesic Limnic Medisaprists
*Elston	Coarse-loamy, mixed, mesic Typic Argiudolls
Fluvaquents	Loamy, mixed, nonacid, mesic Typic Fluvaquents
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Hillsdale	Coarse-loamy, mixed, mesic Typic Hapludalfs
Houghton	Euic, mesic Typic Medisaprists
Linkville	Fine-loamy, mixed, mesic Typic Argiudolls
Martinsville	Fine-loamy, mixed, mesic Typic Hapludalfs
Metea	Loamy, mixed, mesic Arenic Hapludalfs
Milford	Fine, mixed, mesic Typic Haplaquolls
Newton	Sandy, mixed, mesic Typic Humaquepts
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Owosso	Fine-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Pinhook	Coarse-loamy, mixed, mesic Mollic Ochraqualfs
Plainfield	Mixed, mesic Typic Udipsamments
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Shipshe	Loamy-skeletal, mixed, mesic Typic Argiudolls
Stonelick	Coarse-loamy, mixed (calcareous), mesic Typic Udifluvents
*Troxel	Fine-silty, mixed, mesic Typic Argiudolls
Tyner	Mixed, mesic Typic Udipsamments
Udorthents	Loamy, mixed, nonacid, mesic Typic Udorthents
Wallkill	Fine-loamy, mixed, nonacid, mesic Thapto-Histic Fluvaquents
Washtenaw	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
Wawasee	Fine-loamy, mixed, mesic Typic Hapludalfs
Whitaker	Fine-loamy, mixed, mesic Aeric Ochraqualfs

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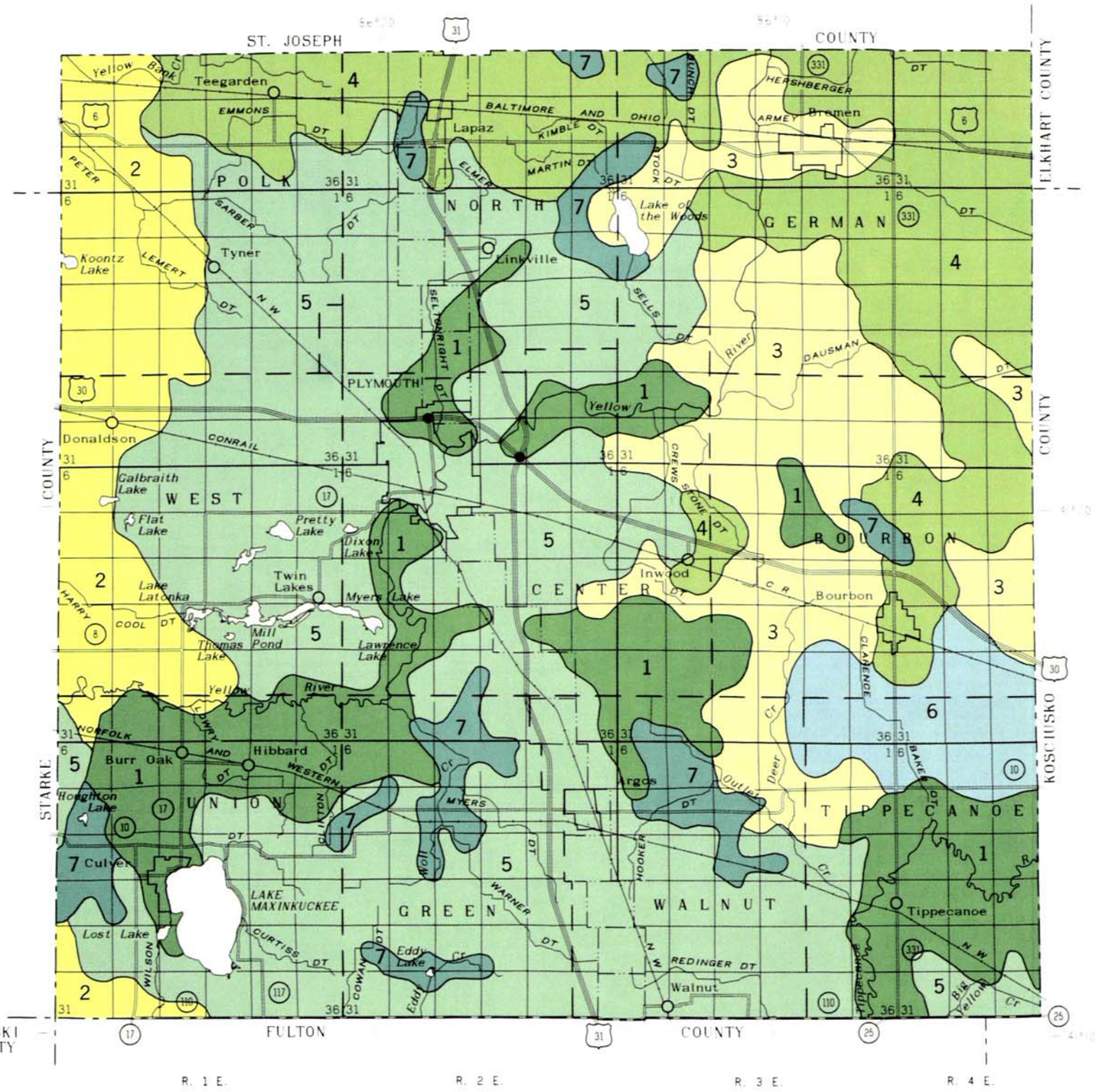


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION
INDIANA DEPARTMENT OF NATURAL RESOURCES
SOIL AND WATER CONSERVATION COMMITTEE

GENERAL SOIL MAP

MARSHALL COUNTY, INDIANA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

SOIL LEGEND

1 — Oshtemo-Owosso-Fox: Nearly level to strongly sloping, well drained, moderately coarse textured and coarse textured soils; some are deep and some are moderately deep over sand and gravel; on outwash plains and moraines

2 — Plainfield-Chelsea-Tyner: Deep, nearly level to strongly sloping, excessively drained and well drained, coarse textured soils; on outwash plains

3 — Rensselaer-Whitaker: Deep, nearly level, very poorly drained and somewhat poorly drained, medium textured soils; on outwash plains, lake plains, and terraces

4 — Crosier-Brookston: Deep, nearly level, somewhat poorly drained and very poorly drained, medium textured soils; on till plains and moraines

5 — Riddles-Metea-Wawasee: Deep, nearly level to strongly sloping, well drained, moderately coarse textured and coarse textured soils; on moraines

6 — Martinsville-Riddles: Deep, nearly level to strongly sloping, well drained, medium textured and moderately coarse textured soils; on terraces, outwash plains, and moraines

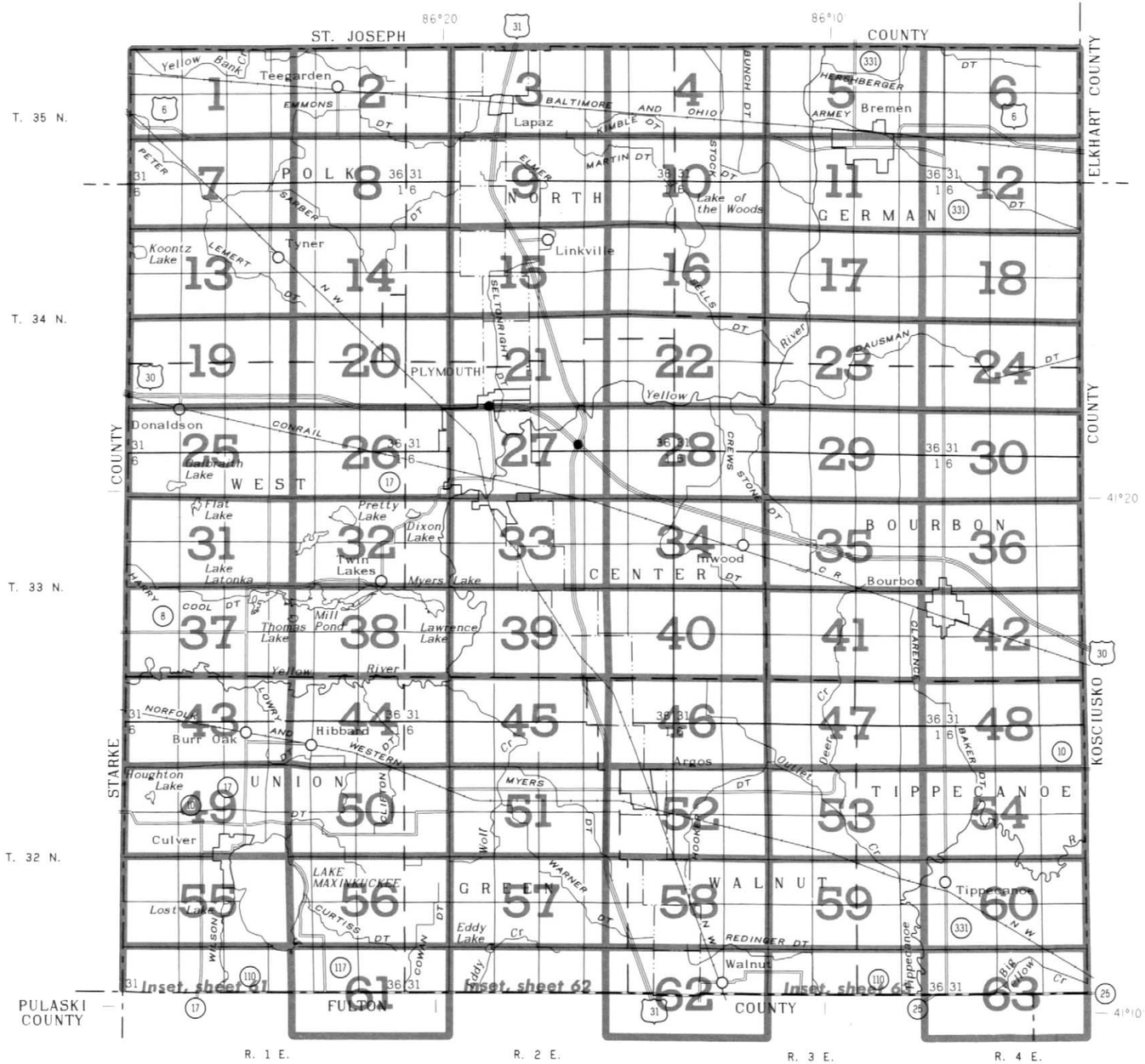
7 — Houghton-Adrian-Palms: Deep, nearly level, very poorly drained, organic soils; in bogs and on old lakebeds on till plains, outwash plains, and moraines

Compiled 1979

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

MARSHALL COUNTY, INDIANA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

N

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and numbers. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded and 3 that it is severely eroded.

SYMBOL	NAME
Ad	Adrian muck, drained
AuA	Aubbeenaubbee sandy loam, 0 to 2 percent slopes
Bd	Brady sandy loam
BeA	Brems sand, 0 to 2 percent slopes
BoA	Bronson loamy sand, 0 to 2 percent slopes
Br	Brookston loam
ChB	Chelsea fine sand, 2 to 6 percent slopes
ChC	Chelsea fine sand, 6 to 12 percent slopes
CtA	Crosier loam, 0 to 2 percent slopes
Ed	Edwards muck, drained
EsA	Elston sandy loam, 0 to 2 percent slopes
Fc	Fluvaquents, loamy
FsA	Fox sandy loam, 0 to 2 percent slopes
FsB	Fox sandy loam, 2 to 6 percent slopes
FsC2	Fox sandy loam, 6 to 12 percent slopes, eroded
Gf	Gilford sandy loam
HdB	Hillsdale sandy loam, 2 to 6 percent slopes
Ho	Houghton muck, drained
Hp	Houghton muck, ponded
LnA	Linkville sandy loam, 0 to 2 percent slopes
LnB	Linkville sandy loam, 2 to 6 percent slopes
MeA	Martinsville loam, 0 to 2 percent slopes
MeB	Martinsville loam, 2 to 6 percent slopes
MeC2	Martinsville loam, 6 to 12 percent slopes, eroded
MgB	Metea loamy fine sand, 2 to 6 percent slopes
MgC	Metea loamy fine sand, 6 to 12 percent slopes
Mn	Milford silty clay loam
Ne	Newton loamy fine sand
OsA	Oshtemo loamy sand, 0 to 2 percent slopes
OsB	Oshtemo loamy sand, 2 to 6 percent slopes
OsC	Oshtemo loamy sand, 6 to 12 percent slopes
OsD	Oshtemo loamy sand, 12 to 18 percent slopes
OwA	Owosso sandy loam, 0 to 2 percent slopes
Pa	Palms muck, drained
PdA	Pinhook sandy loam, 0 to 2 percent slopes
PsA	Plainfield sand, 0 to 2 percent slopes
PsC	Plainfield sand, 3 to 10 percent slopes
PsD	Plainfield sand, 12 to 18 percent slopes
Re	Rensselaer loam
RsA	Riddles sandy loam, 0 to 2 percent slopes
RsB	Riddles sandy loam, 2 to 6 percent slopes
RsC2	Riddles sandy loam, 6 to 12 percent slopes, eroded
RsD	Riddles sandy loam, 12 to 18 percent slopes
SpA	Shipshe sandy loam, 0 to 2 percent slopes
St	Stonelick sandy loam
Tx	Troxel silt loam
TyA	Tyner loamy sand, 0 to 2 percent slopes
TyB	Tyner loamy sand, 2 to 6 percent slopes
TyC	Tyner loamy sand, 6 to 12 percent slopes
Ua	Udorthents, loamy
Wa	Wallkill loam
Wh	Washtenaw silt loam
WkB	Wawasee sandy loam, 2 to 6 percent slopes
WkC2	Wawasee sandy loam, 6 to 12 percent slopes, eroded
WmD3	Wawasee sandy clay loam, 12 to 18 percent slopes, severely eroded
Wt	Whitaker loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline
- AD HOC BOUNDARY (label)
- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (416)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
- Double-line (label) (CANAL)
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water)
- Intermittent (int)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA, FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

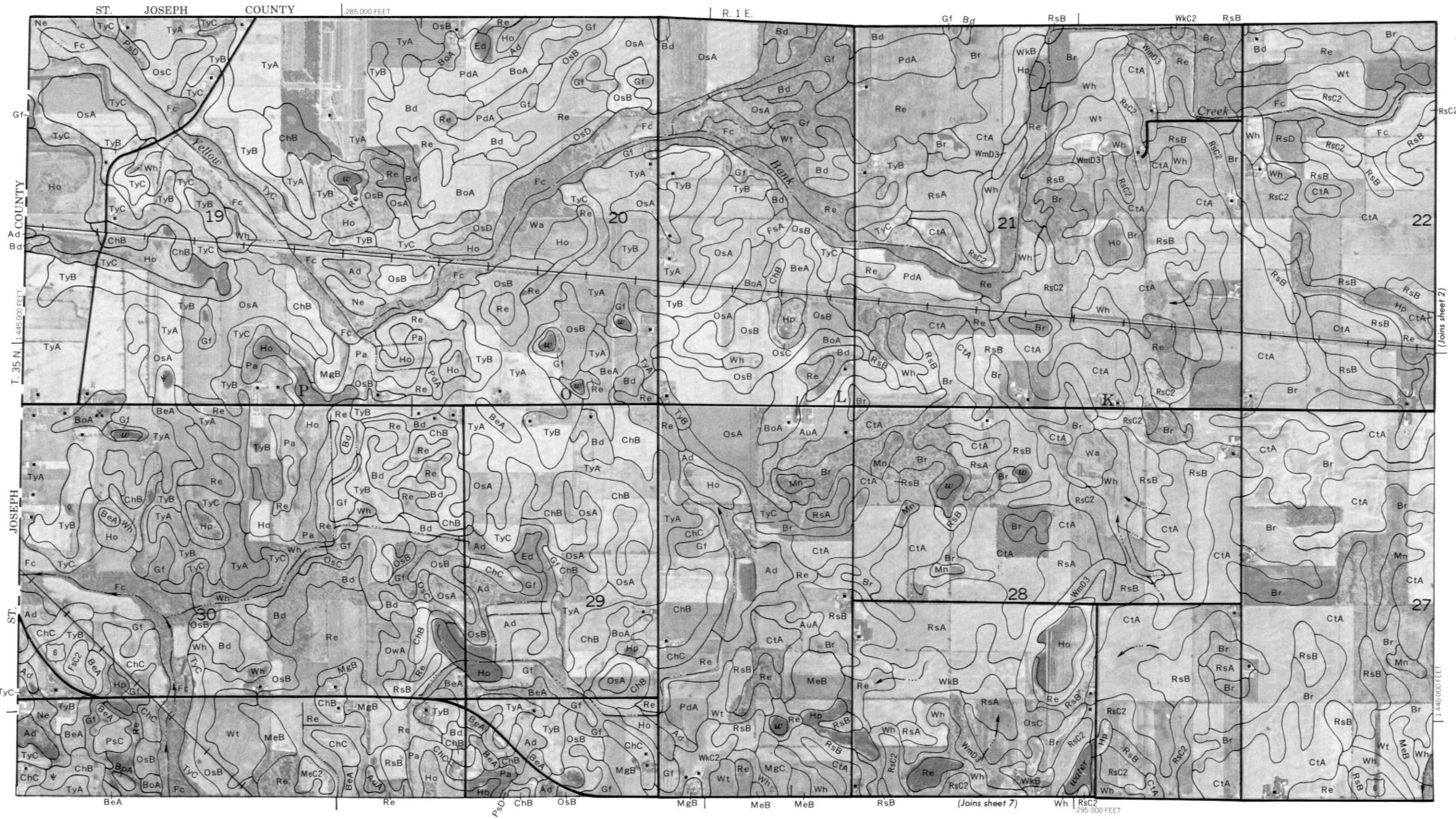
DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot (0)
- Marl spot
- Muck spot

MARSHALL COUNTY, INDIANA — SHEET NUMBER 1



1

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

MARSHALL COUNTY, INDIANA — SHEET NUMBER 2

(2)

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

ST. JOSEPH COUNTY

R. 1 E. | R. 2 E.

315 000 FEET

1 445 000 FEET

1 440 000 FEET

300 000 FEET

T. 35 N.

22 23 24 19 27 26 25 30

P O K L H I G A N

Yellow Bank Creek

Teegarden

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 8)

Br CtA MeB Fc Wt RsC2 RsB RsA Re Mn w AuA Wh Bd PdA BoA FsB MgC WkC2 Wa OwA Wh WkB Ho Pa Hb water

MARSHALL COUNTY, INDIANA — SHEET NUMBER 3

3

N

1 Mile

5 000 Feet

Scale 1:15 840

320 000 FEET

ST. JOSEPH COUNTY

R. 2 E.

ST. JOSEPH COUNTY

T. 35 N.

1 445 000 FEET

1 440 000 FEET

335 000 FEET

Lapaz

Lapaz Junction

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 9)

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 4

4

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R. 2 E. | R. 3 E.

355 000 FEET

T. 35 N. | 1 445 000 FEET

1 440 000 FEET

340 000 FEET

ST. JOSEPH COUNTY

HARRISON

GERMANY

NORTH

23 24 19 20 26 25 30 29

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 10)

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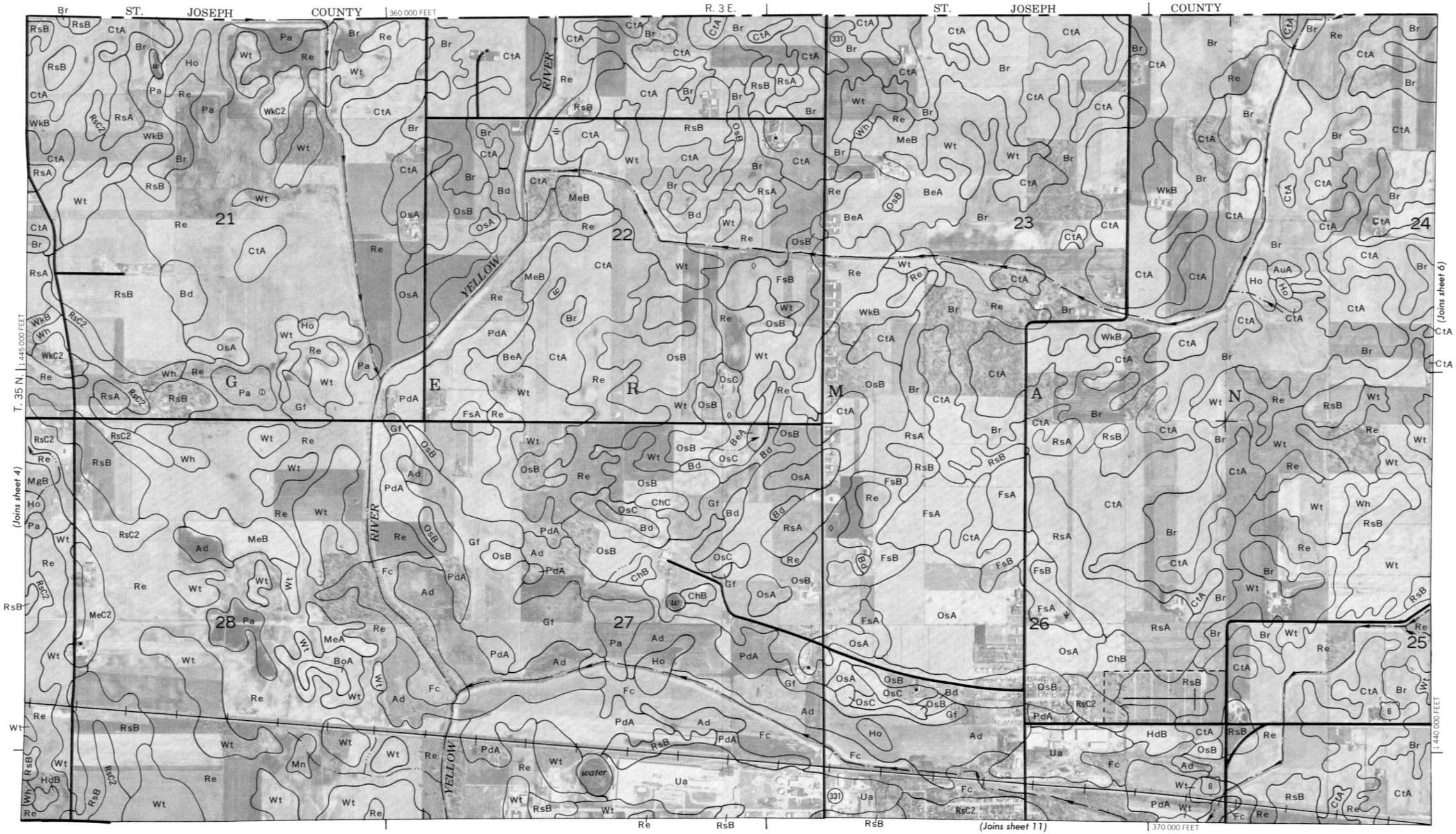
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



5

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

MARSHALL COUNTY, INDIANA — SHEET NUMBER 6

6

N

1 Mile

5,000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

1 440 000 FEET

T. 35 N.

1 445 000 FEET

R. 3 E. | R. 4 E.

ST. JOSEPH COUNTY

390 000 FEET

375 000 FEET

(Joins sheet 5)

(Joins sheet 12)

Wa FsA AuA

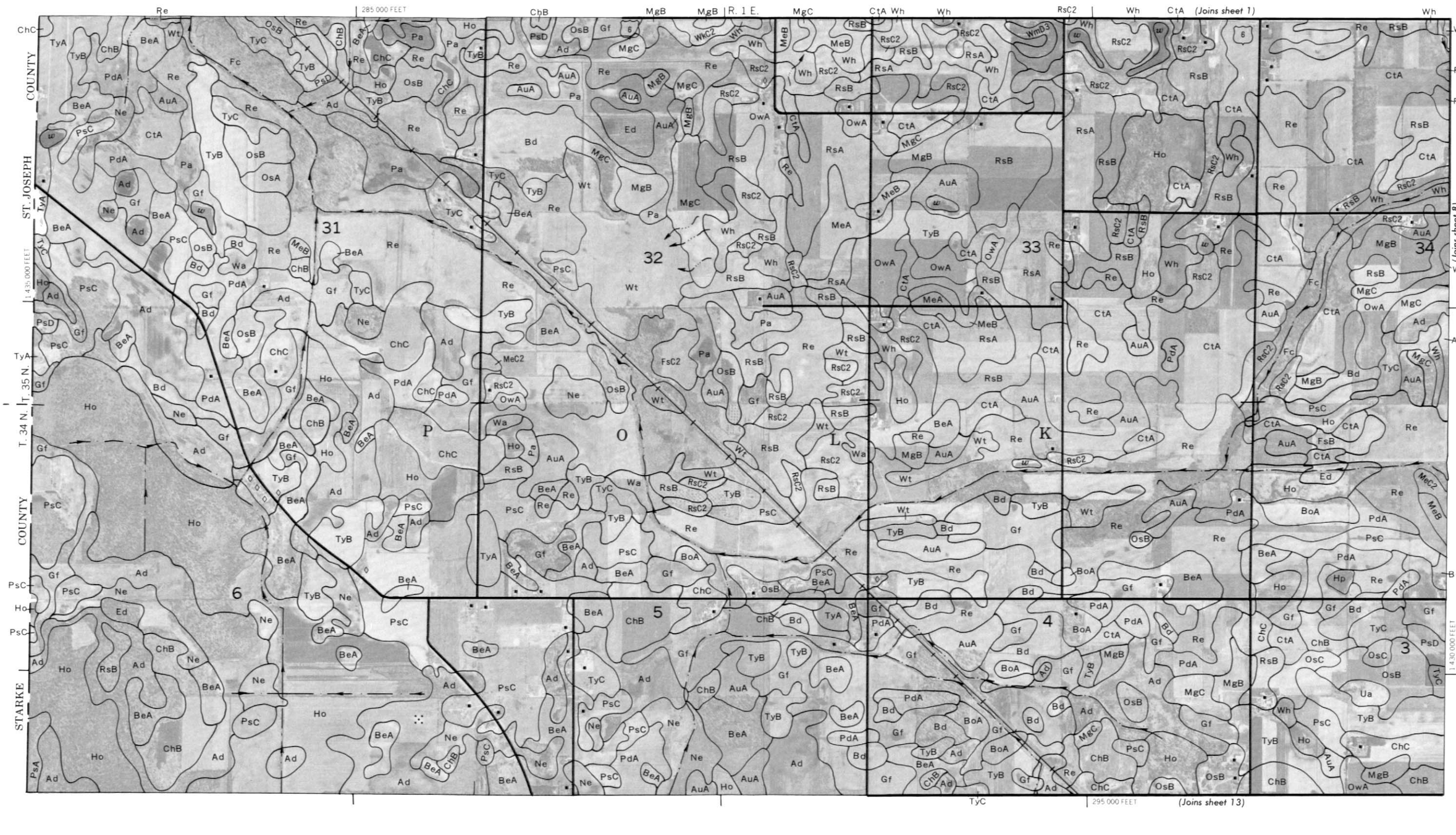
ELKHART COUNTY

19 20 21 24 25 28 29 30

G E R M A N

water

MARSHALL COUNTY, INDIANA — SHEET NUMBER 7



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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

7

N

1 Mile

5,000 Feet

Scale 1:15 840

8

N

1 Mile

5,000 Feet

0

Scale 1:15 840

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

1¼ 5 000

R. 1 E. | R. 2 E.

T. 35 N. | T. 34 N.

315 000 FEET

1 435 000 FEET

1 430 000 FEET

300 000 FEET

(Joins sheet 2)

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 14)

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

9

N

1 Mile

5,000 Feet

Scale 1:15 840

10

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

R. 2 E. | R. 3 E.

T. 35 N. | T. 34 N. (Joins sheet 11)

430 000 FEET

435 000 FEET

340 000 FEET

355 000 FEET

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 16)

Lake of the Woods

NORTH MARSHALL

360 000 FEET

R. 3 E.

(Joins sheet 5)

BREMEN

RIVER

YELLOW

33

34

35

36

1

2

3

4

T. 34 N. | T. 35 N.

1 435 000 FEET

1 430 000 FEET

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 17)

370 000 FEET

11

N

1 Mile

5 000 Feet

Scale 1:15 840

MARSHALL COUNTY, INDIANA — SHEET NUMBER 12

12

N

R. 3 E. | R. 4 E.

(Joins sheet 6)

390,000 FEET

COUNTY

T. 35 N.

ELKHART

1,435,000 FEET

T. 34 N.

COUNTY

KOSCIUSKO

(Joins sheet 11)

1,430,000 FEET

375,000 FEET

(Joins sheet 18)

Scale 1:15 840

1 Mile

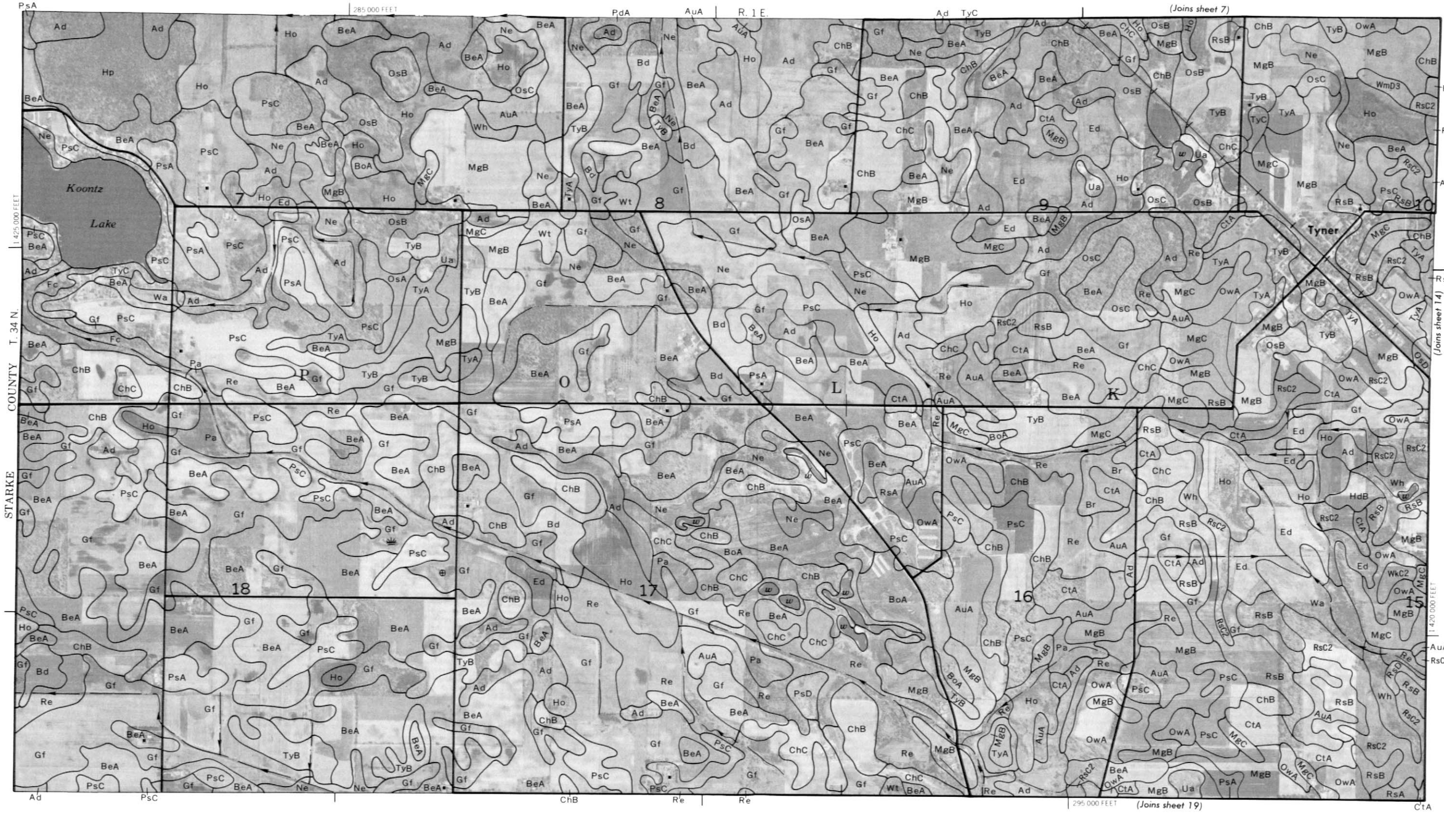
5,000 Feet

This map is compiled on 1972 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies
Soil boundaries shown are approximately positioned
Coordinate grid ticks and land division corners

MARSHALL COUNTY, INDIANA — SHEET NUMBER 13

13

N



1 Mile
5 000 Feet
Scale 1:15 840

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

14

N

1 Mile
5 000 Feet

Scale 1:15 840

1 inch = 1 320 feet
1:20 000 FEET

R. 1 E. | R. 2 E.

T. 34 N.

315 000 FEET

425 000 FEET

300 000 FEET

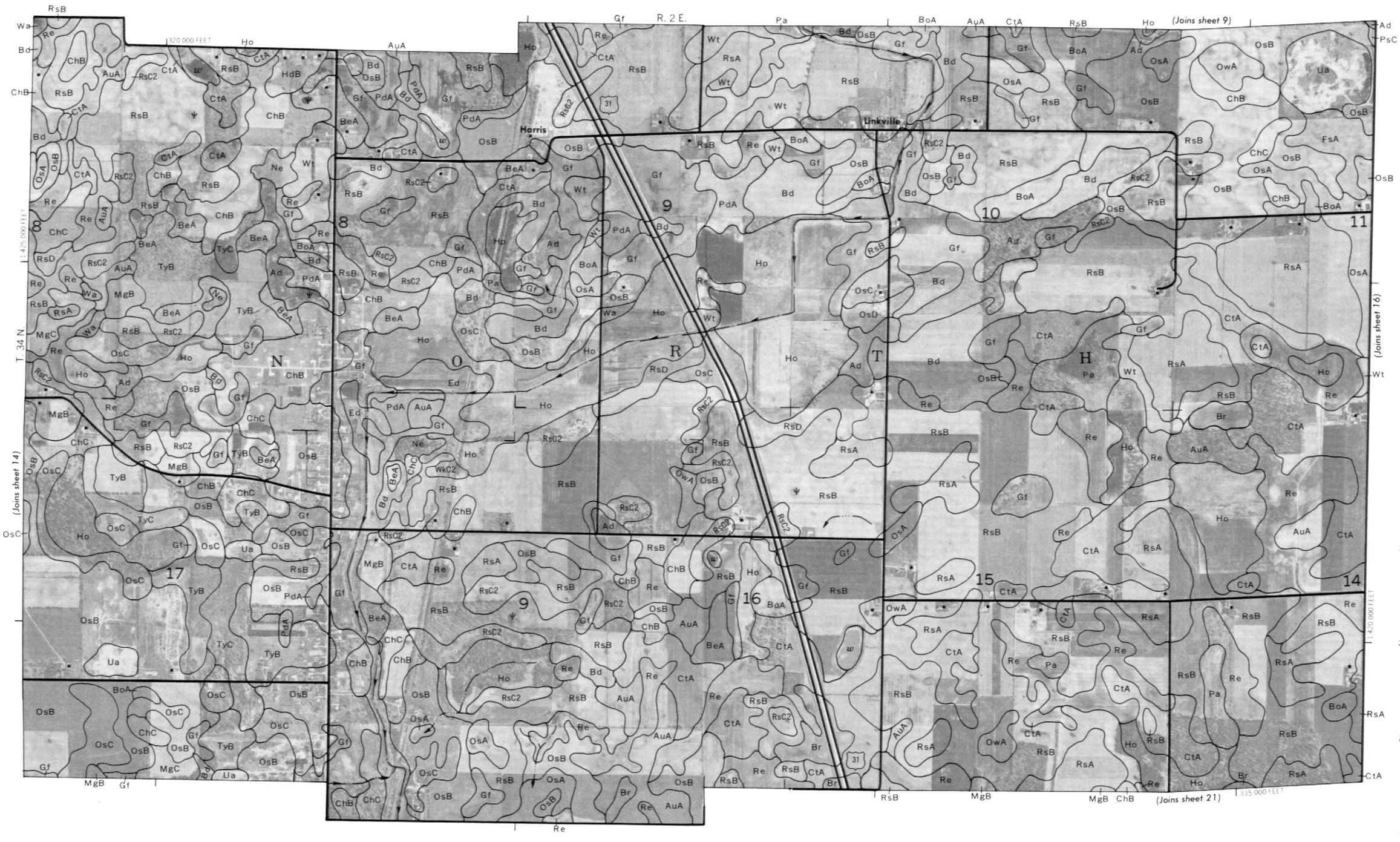
(Joins sheet 8)

(Joins sheet 13)

(Joins sheet 20)

(Joins sheet 15)

10 11 12 7 15 14 13 18 P O L K H T Z



16

N

1 Mile

5,000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1 000 2 000 3 000 4 000 5 000

(Joins sheet 10)

(Joins sheet 15)

(Joins sheet 22)

(Joins sheet 17)

R. 2 E. | R. 3 E.

T. 34 N.

355 000 FEET

1 425 000 FEET

1 420 000 FEET

340 000 FEET

Lake of the Woods

NORTH MARSHALL

11 12 13 14 7 8 18 17

17

N

1 Mile

5 000 Feet

Scale 1:15 840

18

N

1 Mile

5,000 Feet

Scale 1:15 840

R. 3 E. | R. 4 E.

(Joins sheet 12)

(Joins sheet 17)

(Joins sheet 24)

1 420 000 FEET

1 425 000 FEET

375 000 FEET

390 000 FEET

T. 34 N.

KOSCIUSKO COUNTY

12 7 8 9

13 18 17 16

G E R M A N

N

285 000 FEET

R. 1 E.

(Joins sheet 13)

RsA

CtA

MgB

1 Mile

5 000 Feet

T. 34 N.

COUNTY

STARKE

1 415 000 FEET

Donaldson

(Joins sheet 20)

1 410 000 FEET

ChC

MgB

MgB

Wh

WmD3

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 4 000

1 5 000

TyC PsA TyB TyA Gf BeA AuA Gf OwA RsC2 Wa (Joins sheet 25) 295 000 FEET MgB OwA

MARSHALL COUNTY, INDIANA — SHEET NUMBER 20

20

N

1 Mile

5,000 Feet

Scale 1:15 840

R. 1 E. R. 2 E.

T. 34 N.

315 000 FEET

1 415 000 FEET

1 410 000 FEET

300 000 FEET

(Joins sheet 14)

(Joins sheet 19)

(Joins sheet 21)

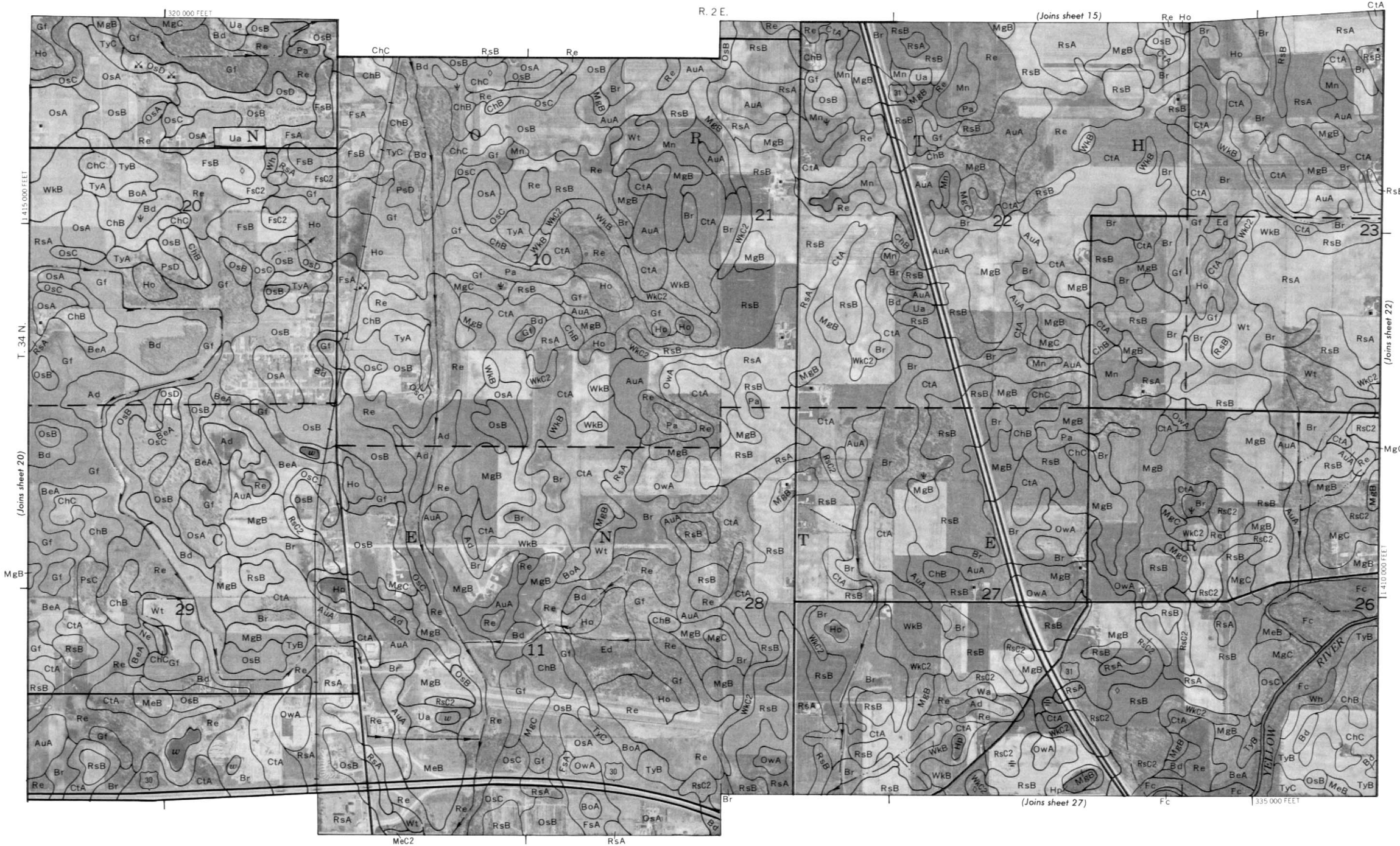
(Joins sheet 26)

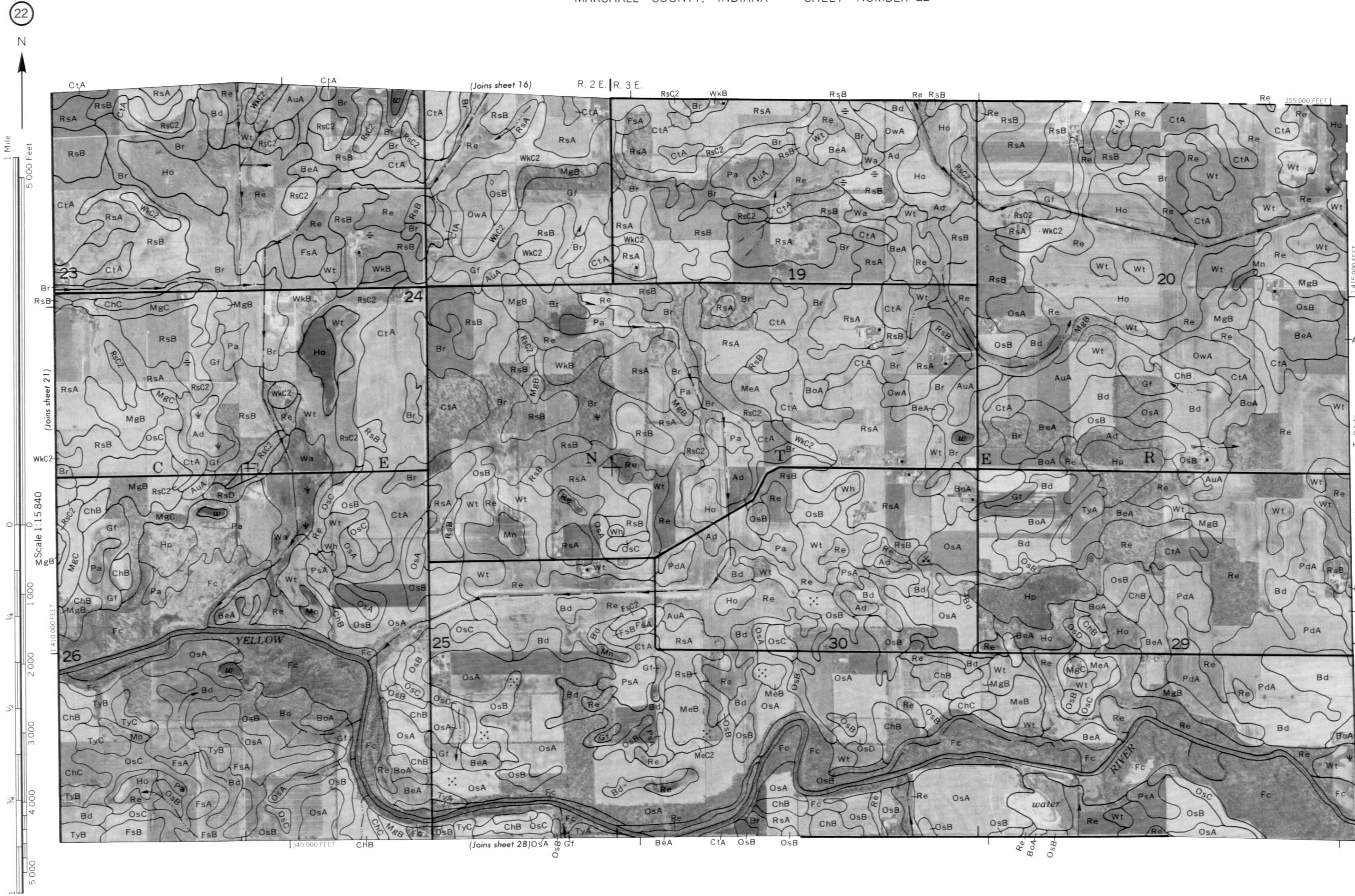
22 23 24 19 27 26 25 30

P O L K N O R T H C E N T E R S E C T I O N S

water

This map is compiled on 1972 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MARSHALL COUNTY, INDIANA — SHEET NUMBER 23

23

N

1 Mile

5 000 Feet

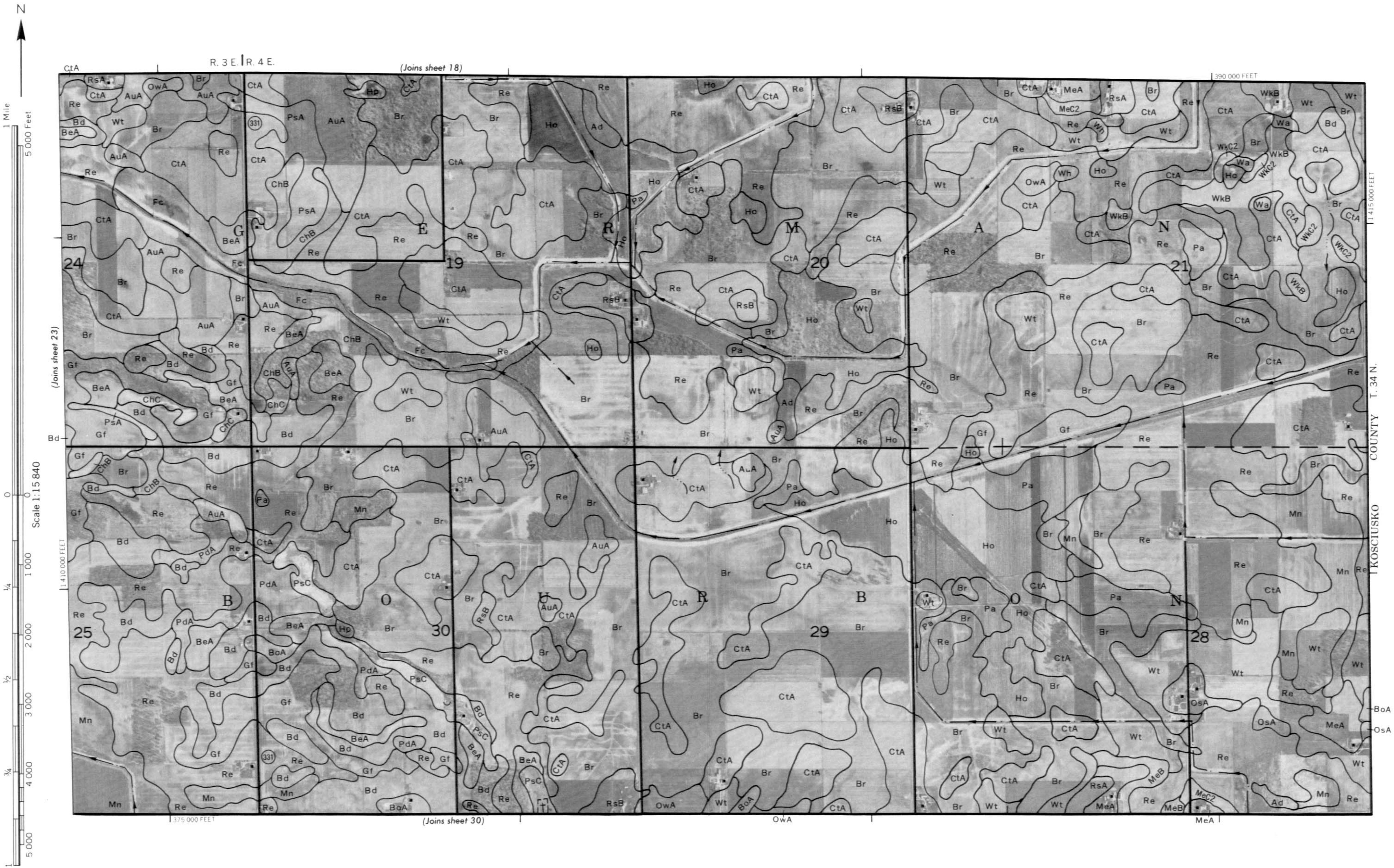
Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 24



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MARSHALL COUNTY, INDIANA — SHEET NUMBER 25

25

N

Donaldson

Galbraith Lake

water

(Joins sheet 19)

(Joins sheet 26)

(Joins sheet 31)

R. 1 E.

T. 34 N.

T. 33 N.

STARKE COUNTY

285 000 FEET

295 000 FEET

1 405 000 FEET

1 400 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MARSHALL COUNTY, INDIANA — SHEET NUMBER 26

(26)

N

(Joins sheet 20)

R. 1 E. | R. 2 E.

315 000 FEET

T. 34 N. | T. 33 N.

(Joins sheet 25)

(Joins sheet 27)

Scale 1:15 840

1 Mile

5 000 Feet

400 000 FEET

300 000 FEET

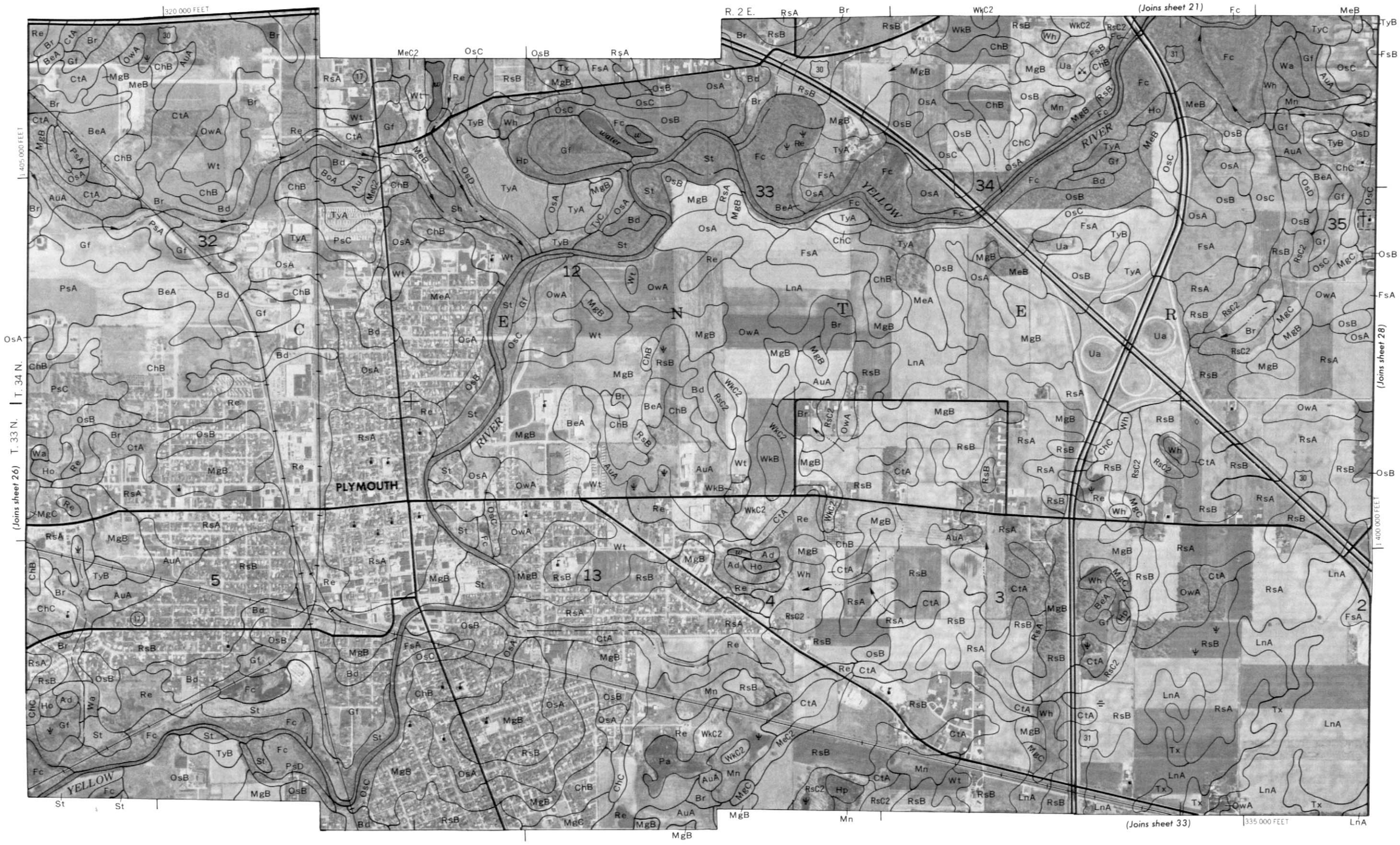
MeA (Joins sheet 32)

MgB

OsB ChB BeA OwA ChB

OsC

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners shown are approximately positioned



28

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 2 E. | R. 3 E.

T. 34 N. | T. 33 N.

(Joins sheet 22)

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 34)

340 000 FEET

355 000 FEET

1 400 000 FEET

35 36 31 32 2 1 6 5

MARSHALL COUNTY, INDIANA — SHEET NUMBER 29

29

N

360 000 FEET

R. 3 E.

(Joins sheet 23)

1 405 000 FEET

T. 34 N.

T. 33 N.

(Joins sheet 28)

(Joins sheet 30)

(Joins sheet 35)

370 000 FEET

1 400 000 FEET

33 34 35 36

4 3 2 1

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

30

N

R. 3 E. | R. 4 E.

(Joins sheet 24)

(Joins sheet 29)

(Joins sheet 36)

390 000 FEET

375 000 FEET

1 400 000 FEET

1 405 000 FEET

T. 34 N. | T. 33 N.

BOURBON

KOSCIUSKO

36 31 32 33 1 6 5 4

Scale 1:15 840

1 Mile 5 000 Feet

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

MARSHALL COUNTY, INDIANA — SHEET NUMBER 31

31

N

R. 1 E.

T. 33 N.

COUNTY

STARKE

1 Mile

5,000 Feet

Scale 1:15 840

1 390 000 FEET

285 000 FEET

295 000 FEET

(Joins sheet 25)

(Joins sheet 32)

(Joins sheet 37)

Flat Lake

water

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 32

32

N

1 Mile

5 000 Feet

Scale 1:15 840

1 320 000 FEET

R. 1 E. | R. 2 E.

315 000 FEET

1 395 000 FEET

T. 33 N

(Joins sheet 31)

(Joins sheet 26)

(Joins sheet 38)

(Joins sheet 33)

300 000 FEET

Pretty Lake

Dixon Lake

Kreighbaum Lake

Cook Lake

Meyers Lake

Twin Lakes

YELLOW RIVER

MARSHALL COUNTY, INDIANA — SHEET NUMBER 33

33

N

1 Mile

5,000 Feet

Scale 1:15 840

320 000 FEET

1 395 000 FEET

1 390 000 FEET

335 000 FEET

R. 2 E.

T. 33 N.

(Joins sheet 27)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 39)

RIVER

YELLOW

8 9 10 11 14 15 16 17

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

34

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 28)

R. 2 E. | R. 3 E.

355 000 FEET

1 395 000 FEET

T. 33 N.

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 40)

340 000 FEET

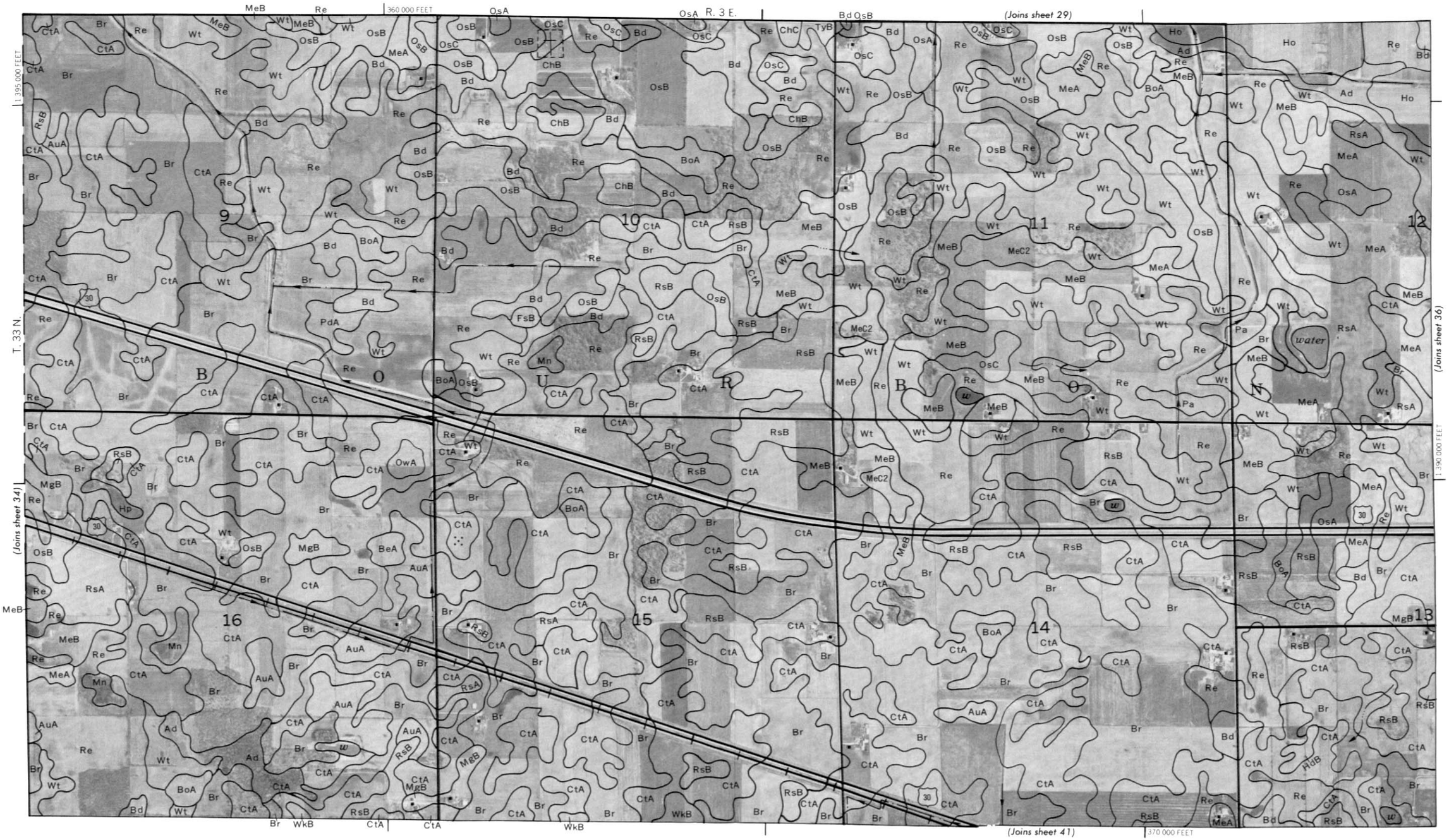
1 390 000 FEET

11 12 13 14 7 8 18 17

inwood

water

This map is compiled on 1972 aerial photographs by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



35

N

1 Mile

5 000 Feet

Scale 1:15 840

MARSHALL COUNTY, INDIANA — SHEET NUMBER 36

36

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 3 E. | R. 4 E. (Joins sheet 30)

390 000 FEET

1 395 000 FEET

1 390 000 FEET

375 000 FEET

(Joins sheet 35)

(Joins sheet 42)

T. 33 N.

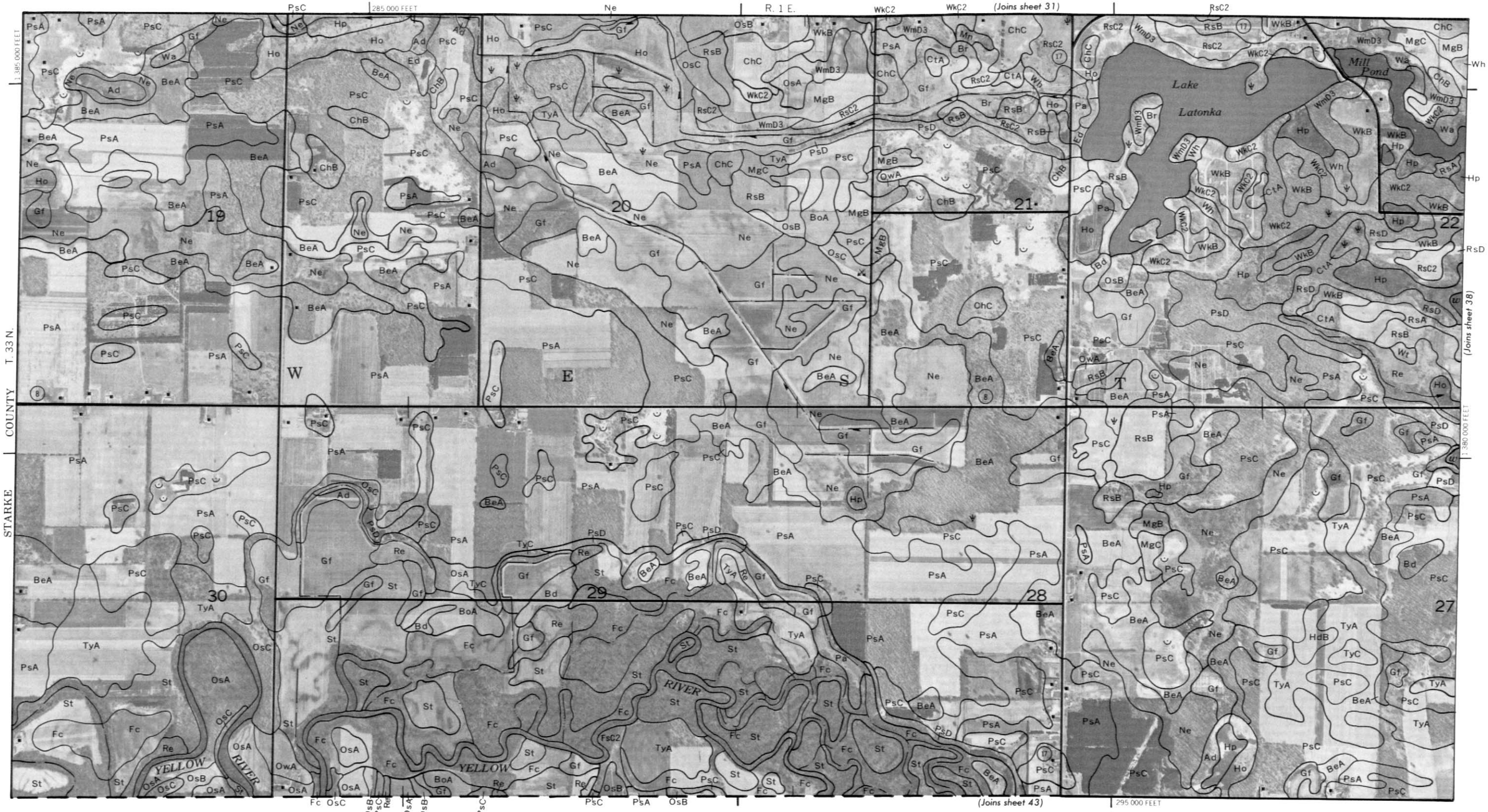
BOURBON

ROSCIUSKO COUNTY

12 7 8 9 13 18 17 16

Bourbon

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned



37

N

1 Mile

5 000 Feet

Scale 1:15 840

MARSHALL COUNTY, INDIANA — SHEET NUMBER 38

38

N

R. 1 E. | R. 2 E.

T. 33 N.

(Joins sheet 32)

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 44)

315 000 FEET

385 000 FEET

380 000 FEET

300 000 FEET

Kreighbaum Lake

Cook Lake

Meyers Lake

Mill Pond

Holem Lake

Laurence Lake

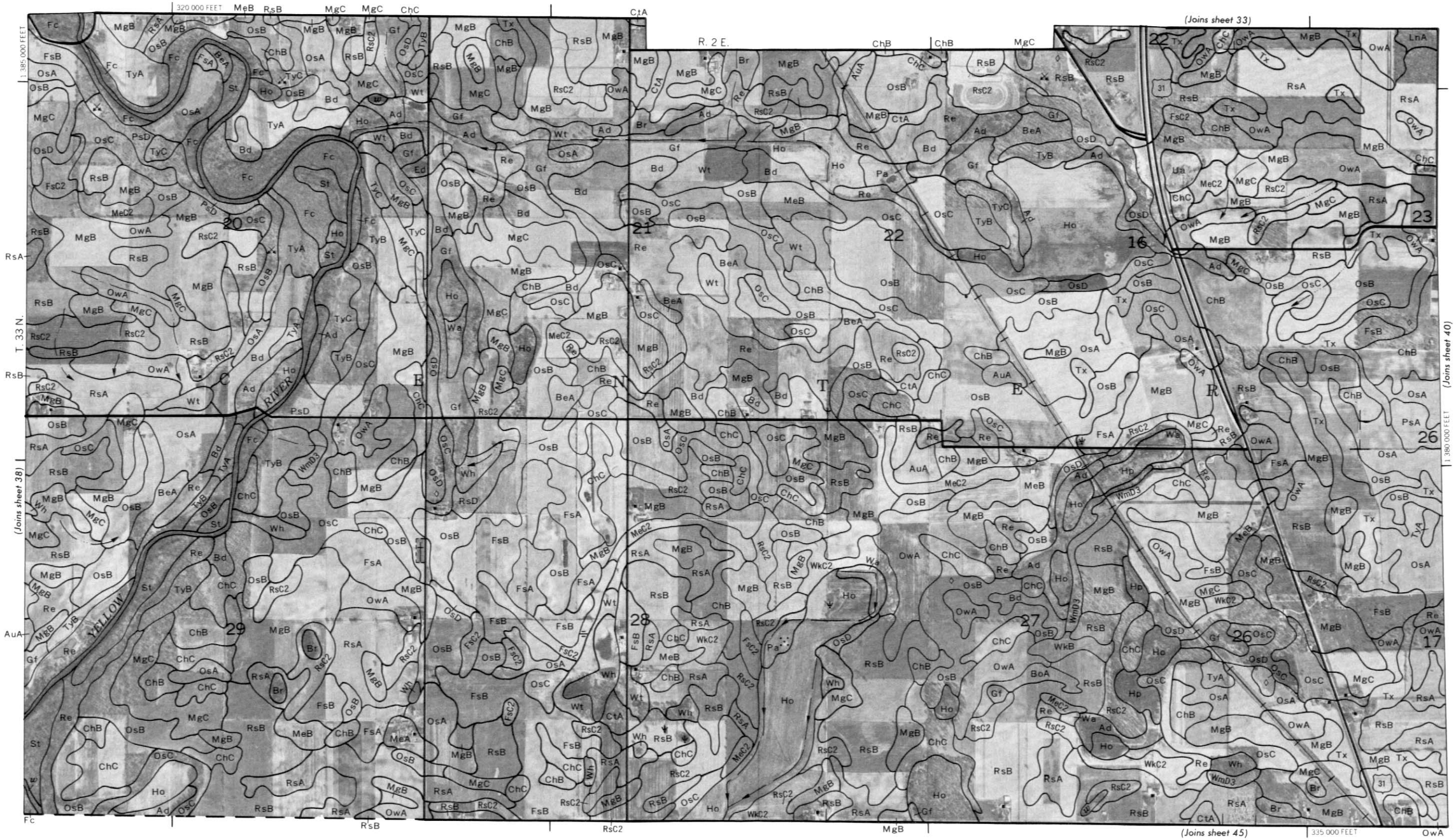
Thomas Lake

Scale 1:15 840

1 Mile

5 000 Feet

This map is compiled on 1972 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

1/4 1 000

1/2 2 000 3 000

3/4 4 000

1 5 000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

40

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

(Joins sheet 34)

(Joins sheet 39)

(Joins sheet 46)

(Joins sheet 41)

R. 2 E. R. 3 E.

T. 33 N.

1 380 000 FEET

1 385 000 FEET

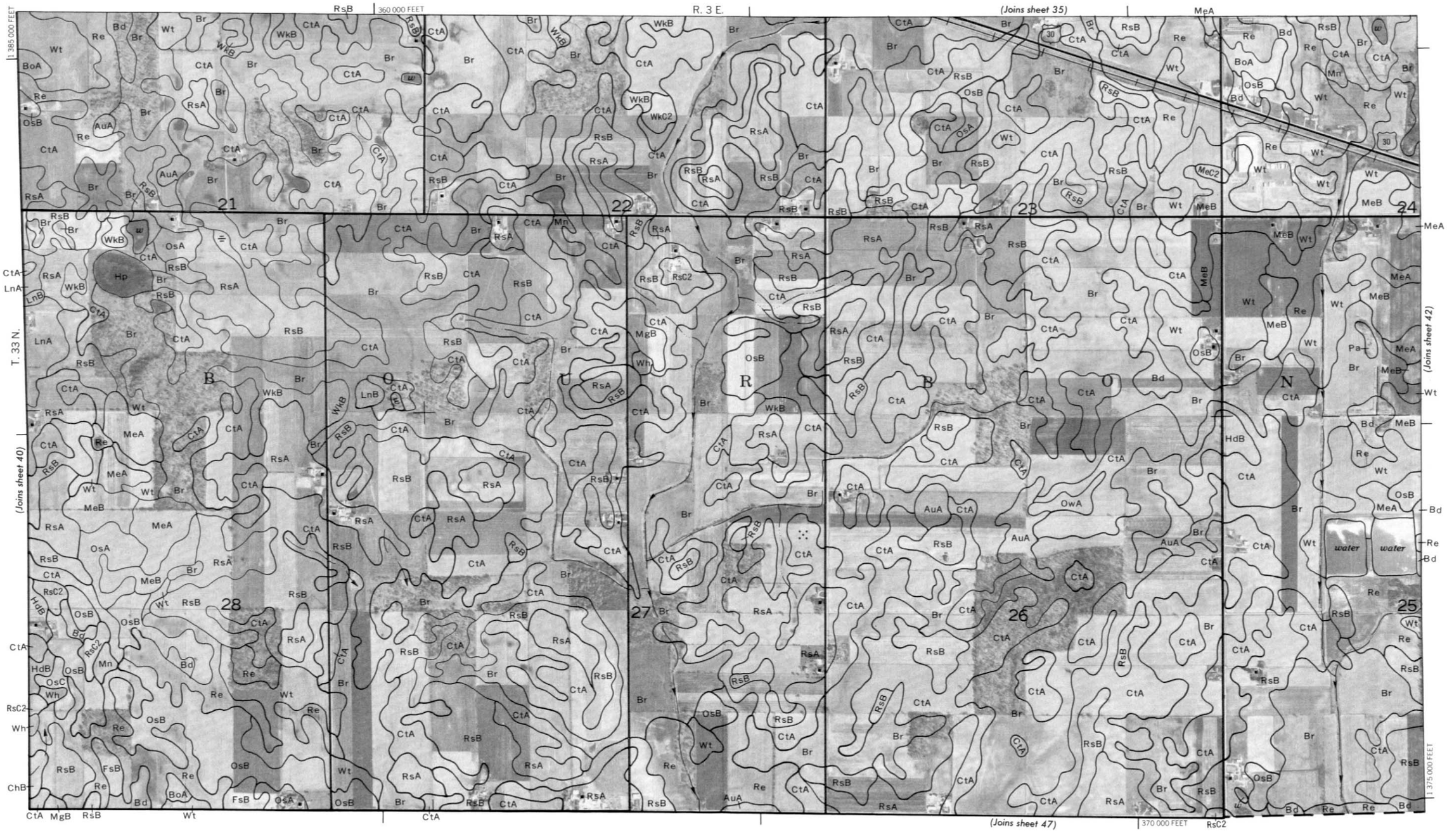
340 000 FEET

355 000 FEET

23 24 19 20 26 25 25 30 29 17

CtA HdB Wh RsB

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned



41

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

1 1/4 5 000

42

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 3 E. R. 4 E. (Joins sheet 36)

390 000 FEET

1 385 000 FEET

1 375 000 FEET

375 000 FEET

(Joins sheet 41)

(Joins sheet 48)

T. 33 N.

COUNTY

KOSCIUSKO

Bourbon

19 20 21

24 25 30 29 28

BOURBON

MARSHALL COUNTY, INDIANA — SHEET NUMBER 43

43

N

R. 1 E.

285 000 FEET

1 375 000 FEET

T. 33 N.

T. 32 N.

COUNTY

STARKE

YELLOW RIVER

Burr Oak

water

(Joins sheet 37)

(Joins sheet 44)

(Joins sheet 49)

295 000 FEET

1 365 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

(44)

N

1 Mile

5 000 Feet

(Joins sheet 38)

(Joins sheet 43)

(Joins sheet 50)

(Joins sheet 45)

315 000 FEET

300 000 FEET

1 375 000 FEET

1 365 000 FEET

R. 1 E.

R. 2 E.

T. 32 N.

INDIANA

YELLOW RIVER

Hibbard

Rutland

water

35

36

34

31

3

2

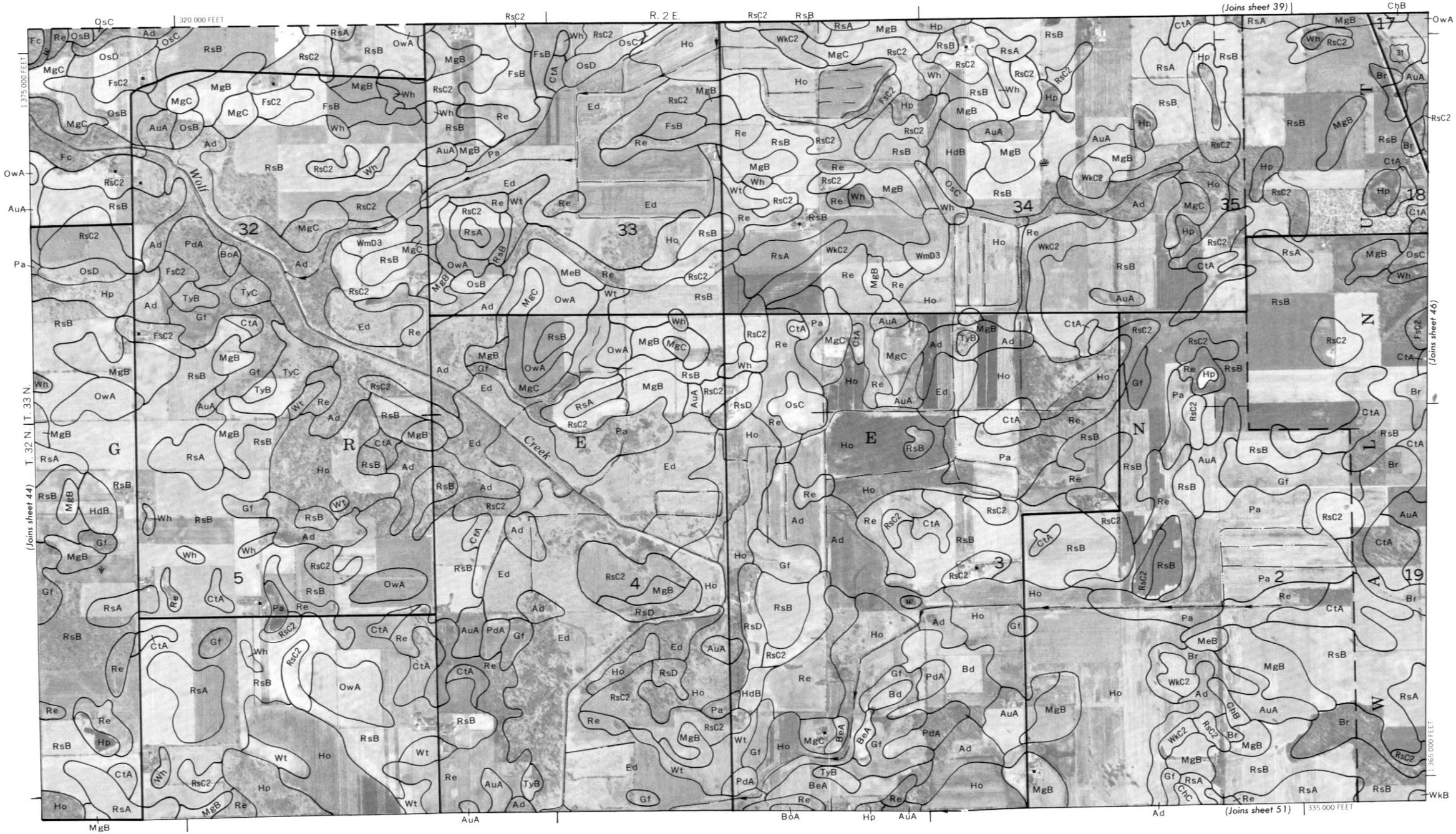
1

6

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1



46

N

1 Mile

5 000 Feet

R. 2 E., R. 3 E.

T. 32 N.

T. 33 N.

355 000 FEET

1 375 000 FEET

340 000 FEET

1 365 000 FEET

MgB (Joins sheet 40)

(Joins sheet 45)

(Joins sheet 47)

(Joins sheet 52)

17 18 19 36 31 32 1 6 5

W A L N U T Creek

water

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 1¼ 5 000

47

N

1 Mile

5,000 Feet

Scale 1:15 840

1 000 0 1 000 2 000 3 000 4 000 5 000 FEET

1/4 1/2 3/4

1 375 000 FEET

360 000 FEET

R. 3 E.

(Joins sheet 41)

T. 32 N.

T. 33 N.

(Joins sheet 46)

(Joins sheet 48)

(Joins sheet 53)

365 000 FEET

370 000 FEET

33 34 35 36 4 3 2 1 10

WALNUT TOWNSHIP

Deep Creek

48

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 3 E. | R. 4 E.

(Joins sheet 42)

(Joins sheet 47)

(Joins sheet 54)

390 000 FEET

1 375 000 FEET

1 562 000 FEET

375 000 FEET

T. 32 N. | T. 33 N.

KOSCIUSKO COUNTY

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners if shown are approximately positioned.

N

R. 1 E.

280 000 FEET

295 000 FEET

1 360 000 FEET

1 355 000 FEET

T. 32 N.

COUNTY

STARKE

Houghton Lake

Moore Lake

LAKE MAXINKUCKEE

CULVER

AuA (Joins sheet 43)

(Joins sheet 50)

(Joins sheet 55)

1 Mile

5 000 Feet

Scale 1:15 840

0 0 1/4 1 000 1/2 2 000 3/4 4 000 1 5 000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 50

50

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 44)

(Joins sheet 49)

(Joins sheet 56)

(Joins sheet 51)

R. 1 E. | R. 2 E.

315 000 FEET

360 000 FEET

355 000 FEET

300 000 FEET

T. 32 N.

10 11 12 7 15 14 13 18

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

320 000 FEET

R. 2 E.

(Joins sheet 45)

WALNUT

T. 32 N.

360 000 FEET

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 57)

355 000 FEET

Wolf Creek

Wolf

water

1 Mile

5 000 Feet

Scale 1:15 840

52

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

0 1 000 2 000 3 000 4 000 5 000

355 000 FEET

340 000 FEET

T. 32 N.

R. 2 E. | R. 3 E.

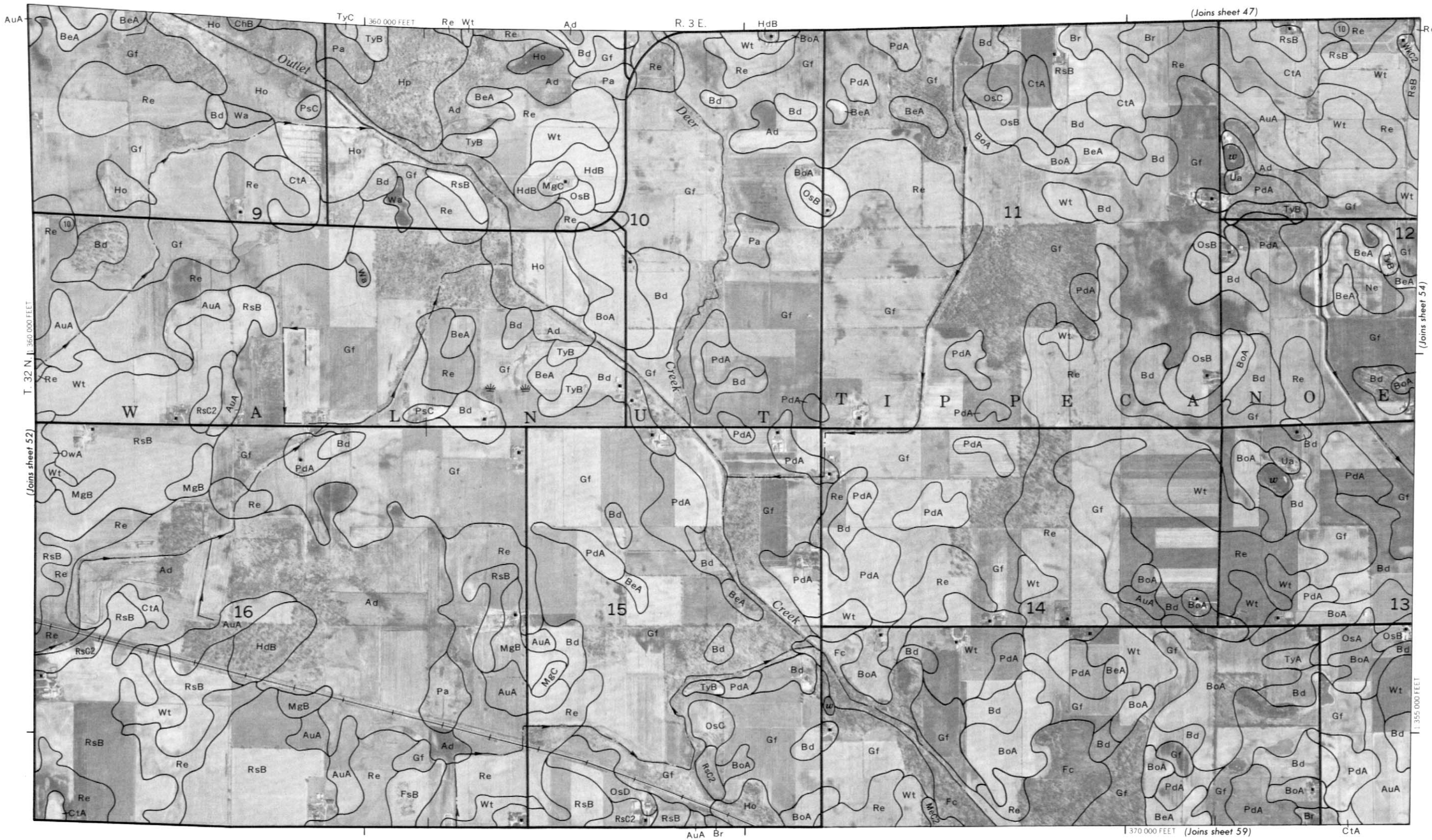
(Joins sheet 46)

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 58)

ARGOS



54

N

1 Mile

5 000 Feet

0

Scale 1:15 840

0

¼

1 000

½

2 000

¾

3 000

1

4 000

1¼

5 000

R. 3 E. | R. 4 E.

(Joins sheet 48)

390 000 FEET

(Joins sheet 53)

1 355 000 FEET

375 000 FEET

(Joins sheet 60)

1 360 000 FEET

T. 32 N.

COUNTY

KOSCIUSKO

RIVER

TIPPECANOE

Old Tip Town

water

12 7 8 9 13 18 17 16

TIPPECANOE

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 55

55

N

280 000 FEET

R. 1 E.

(Joins sheet 49)

CULVER

LAKE MAXINKUCKEE

Lost Lake

(Joins sheet 56)

T. 32 N.

1 350 000 FEET

STARKE COUNTY

19 20 21 30 29 28

1 345 000 FEET

295 000 FEET

(Joins inset, sheet 61)

Scale 1:15 840

1 Mile

5 000 Feet

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

56

N

1 Mile

5,000 Feet

Scale 1:15 840

(Joins sheet 50)

(Joins sheet 55)

(Joins sheet 61)

(Joins sheet 57)

R. 1 E.

R. 2 E.

315 000 FEET

T. 32 N.

350 000 FEET

345 000 FEET

300 000 FEET

LAKE

MAXINKUCKEE

Maxinkuckee

Mud Lake

UNION

GREEN

22

23

24

19.

27

26

25

30

320 000 FEET

R. 2 E.

(Joins sheet 51)

T. 32 N.

1 350 000 FEET

(Joins sheet 56)

(Joins sheet 58)

(Joins inset, 62)

335 000 FEET

1 345 000 FEET

20 21 22 23 26 27 28 29

57

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

MARSHALL COUNTY, INDIANA — SHEET NUMBER 58

58

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 57)

(Joins sheet 52)

R. 2 E. R. 3 E.

355 000 FEET

T. 32 N.

1 350 000 FEET

1 345 000 FEET

340 000 FEET

(Joins sheet 62)

(Joins sheet 59)

23 24 22 19 20 26 25 23 30 29 31

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners of U.S. Public Land Survey are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 59

59

N

1 Mile

5 000 Feet

Scale 1:15 840

360 000 FEET

R. 3 E.

BeA

(Joins sheet 53)

T. 32 N.

1 350 000 FEET

(Joins sheet 58)

(Joins sheet 60)

1 345 000 FEET

370 000 FEET

(Joins inset, 63)

WALNUT

OLIVE

PIKE

Outlet

Creek

RIVER

TIPPECANOE

21 22 23 24 25 26 27 28

CtA RsB OsB WkB

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

MARSHALL COUNTY, INDIANA — SHEET NUMBER 60

60

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

R. 3 E. | R. 4 E.

(Joins sheet 54)

390 000 FEET

1 350 000 FEET

T. 32 N.

1 345 000 FEET

375 000 FEET

(Joins sheet 59)

(Joins sheet 63)

TIPPECANOE RIVER

Tippecanoe

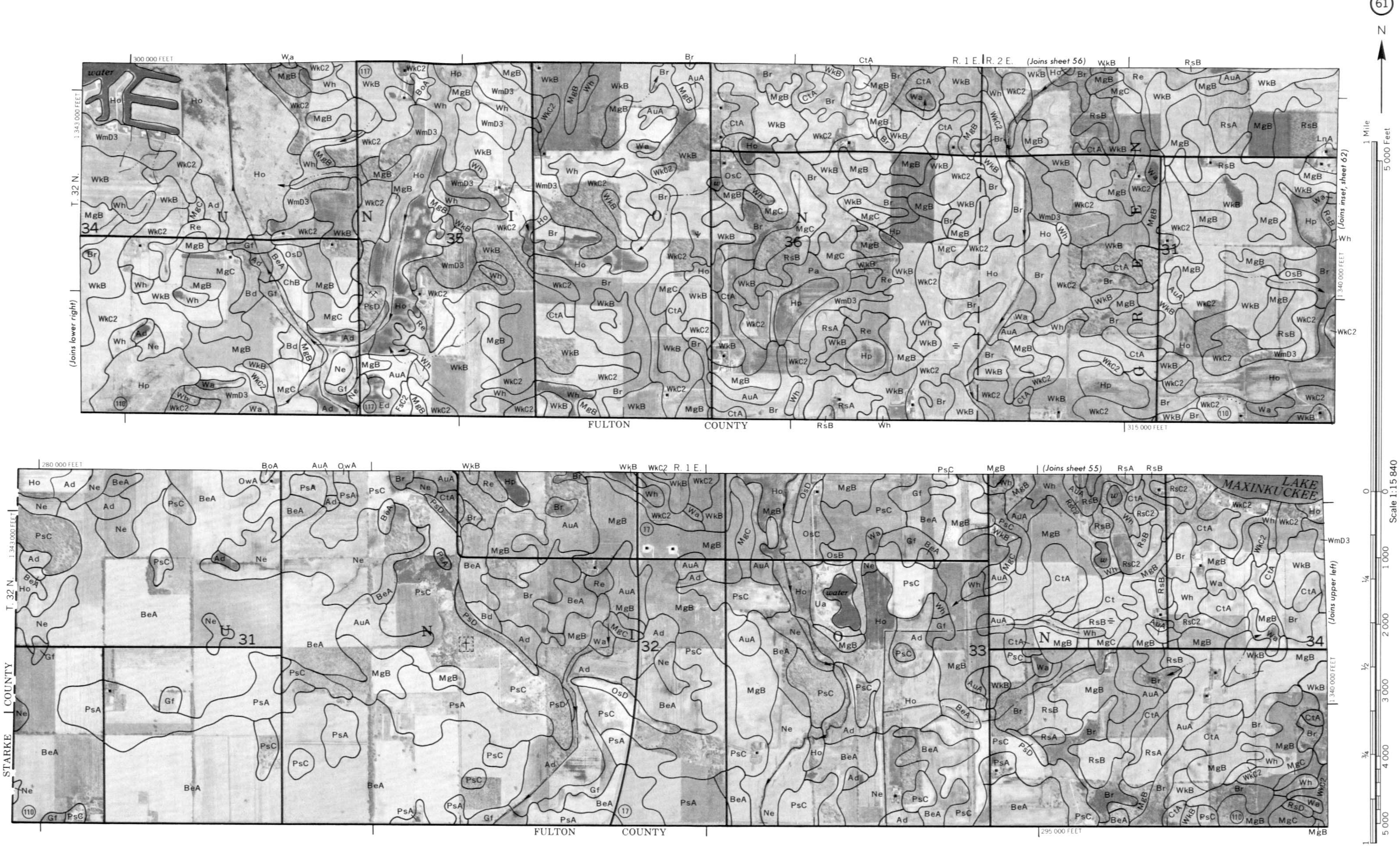
water

19 20 21 24 25 30 29 28

TIPPECANOE COUNTY

KOSCIUSKO COUNTY

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

62

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 58)

R. 2 E. | R. 3 E.

355 000 FEET

1 343000 FEET

T. 32 N.

(Joins lower right)

1 340 000 FEET

35 36 24 31 32

WAYNE

TOWNSHIP

FULTON COUNTY

340 000 FEET

(Joins inset, sheet 63)

(Joins sheet 61)

AuA | (Joins sheet 57) | Ed | WmD3 | ChC | R. 2 E. | Re | RsB | ChC | RsC2 | 335 000 FEET

1 340 000 FEET

32 33 34 35

GREEN TOWNSHIP

320 000 FEET

(Joins upper left)

N

R. 3 E. | R. 4 E.

375 000 FEET

1 343 000 FEET

T. 32 N.

(Joins lower right)

(Joins sheet 60)

1 340 000 FEET

KOSCIUSKO COUNTY

FULTON COUNTY

KOSCIUSKO COUNTY

390 000 FEET

Yellow Creek

TIPPECANOE RIVER

(Joins sheet 62)

360 000 FEET

R. 3 E.

(Joins sheet 59)

370 000 FEET

FULTON COUNTY

(Joins upper left)

1 Mile

5 000 Feet

Scale 1:15 840